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ASSESSMENT OF HOUSEHOLDS' FOOD SECURITY AND PRODUCTION CONSTRAINTS OF MAIZE FARMERS IN KADUNA STATE, NIGERIA

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ABSTRACT
The study was conducted to assess households' food security and production constraints of maize farmers in Kaduna State, Nigeria. Primary data through structured questionnaire and interview, administered to randomly select 258 maize farmers from 20 villages and four (4) LGAs of Kaduna State, Nigeria. The research questions were analysed with aid of descriptive statistics, food security index and Tobit regression model. The result indicated that that approximately 62% of the sampled households were food secure. The food security indices for the food secure and insecure households estimated to be 1.84 and 0.47, respectively, while the food security index for the pooled data was 2.10. The value of 1.84 for the food secure household indicates a surplus of 0.84 among the food secured households. The average daily calorie consumption for the food secure household was 4165.63 Kcal, and this implied an excess in calorie consumption of the recommended by 1905.63 Kcal. The regression result showed that the level of food security ($P<0.01$), output of maize ($P<0.01$), age of household head ($P<0.01$), household size ($P<0.01$), farming experience ($P<0.01$), and off-farm income ($P<0.10$) were found to be significantly affecting the food security status of the maize farmers. Inadequate access to credit and storage facilities and low extension service delivery were most critical constraints faced by maize farmers. The study, therefore, recommended that cooperative societies should be encouraged to enable the farmers' group to have increased access to credit, access to modern farming techniques and access to extension agents.

Keywords: Credit, Food insecure, Nigeria, Maize, Regression.

INTRODUCTION
The agricultural sector largely contributes to the well-being of the rural poor by sustaining about 86% of rural households in the country. The sector contributed about 25% to the real GDP of the economy in 2018 (NBS [National Bureau of Statistics], 2018). Maize is one of the main cereal staple foods produced in large quantities in Nigeria, and its importance in the country's economy cannot be over emphasized, especially in terms of its potential to mitigate the present food insecurity and alleviate poverty (Fabunmi *et al.*, 2015). The bulk of maize production in Nigeria is largely by rural farmers who are poor, resource-constrained, risk-averse, and cultivate maize mainly on a small-scale basis leading to lower productivity and depletion in farming households' food security. This poses a serious threat to the social and economic status of small-scale farmers. According to Jimjel *et al.* (2014), despite the economic importance of maize to the increasing population, and its widespread contribution to the economy of the country and particularly a panacea for food insecurity, research findings had shown it has not being produced to meet the food and industrial needs of the country.

Girei *et al.* (2018) noted that the average annual demand for maize in Nigeria was about 10.9 million metric tonnes in 2017, while the average production was estimated to be 10.5 million metric tonnes thus, giving a gap deficit of 0.4 million metric tonnes. The shortfall is

been bridged by import, which depletes Nigeria's foreign reserve and exports the much-needed jobs to other countries.

Household food security exists when all members, at all times, have access to enough food for an active, healthy life. Individuals who are food secure do not live in hunger or fear of starvation (FAO, 2018). On the other hand, food insecurity is a situation of limited or uncertain availability of nutritionally adequate and safe foods or limited or uncertain ability to acquire acceptable foods in socially acceptable ways (Gary *et al.,* 2000). Having understood the fact that maize is an important cereal majorly consumed by rural households, it is noteworthy to also understand the food security status of farming households, whether they are food secured, marginally food insecure, moderately food insecure, or severely food insecure.

Generally, in agricultural production, an efficient use of the existing resources by farm households improves their productivity, increases their output, and thereby improves their living standard (Gaspard, 2017). In view of the strategic importance of maize to farming households in Nigeria, there is the need to investigate the food security status of maize farmers in the study area. However, few researches have considered rational resource allocation for the improvement in efficiency in Kaduna state. All these studies focused mainly on profitability and/or economic viability without empirical evidence ascertaining the effect of maize production on food security of farming households. Some of the factors influencing their food security were not empirically articulated.

Furthermore, achieving food security in its totality has been a major challenge not only to developing nations but also to the developed world. According to FAO (2018), an estimated 821 million people worldwide are still undernourished and almost 20.4% of people in Africa are chronically undernourished. The situation globally is severe with the number of hungry people amount to 925 million in 2010 or 16% of the population (Hoddinott *et al.*, 2012). In Nigeria, the situation is not different as Kumolu (2010); and Nkeme *et al.* (2017) reported that about 40 million people in Nigeria are hungry and a large percentage of the population lack access to adequate food.

This study enables us to obtain adequate, sufficient and reliable data for analysis geared towards meaningful policy formulation for maize production in Kaduna State. The study did not only examine the food security status of maize production in the study area, but also established the effects of maize production on food security status of farming households. In an attempt to do this, the study provided answers to the following research questions of what were the:

i. food security status of maize farming households?
ii. effects of maize production on household food security status?
iii. constraints associated with maize production?

The hypothesis put forward for the study was that maize production does not have significant effect on food security of the households in the study area.

MATERIALS AND METHODS

The Study Area

The study was took place in Kaduna State, Nigeria. The State is located between latitudes 9° $00^{`-}$ N and $11^{0}$ $30^{`-}$ N and longitudes 6° $00^{`-}$ E and $9^{\circ}$ $10^{`-}$ E of the prime meridian (Kaduna Agricultural Development Agency, KADA, 2018). The State occupies an area of about of 46,053 square kilometres, with a projected population of 8,789,003 in 2019 at an annual growth rate of 3.2% (NPC, 2016 and NBS, 2016). The State is within the derived savannah zone of Nigeria. The weather is dry and wet seasons. Rainfall is between 1837 mm

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and 3236 mm. The state has a mean annual temperature of 25.2 °C, April being the warmest month about 28.6 °C (KADA 2018).

Sampling Procedure

The study used a multistage sampling procedure. The first stage involved the selection of the four (4) agricultural zones (Table 1) comprising 23 Local Government Areas (LGAs). The second stage involved the random selection of one (1) LGA each in three (3) of the agricultural zones selected using a simple balloting system.

Table 1: Population and Sample Size of Maize Farmers

Zones	LGA	Villages	10% of villages	Name of villages	Sample frame	Sample size
Maigana	Soba	33	3	Gamagira	212	21
				Rahama	174	17
				Gimba	122	12
Sub-total					508	50
Lere	Lere	68	7	Raminkura	226	23
				Sabon Birnin	271	27
				Sigau	147	15
				Gogon Jeji	109	11
				Danlahaji	58	6
				Jingre	77	8
				Woba	41	4
Sub-total					929	94
Samaru Kataf	Jaba	61	6	Kwoi	181	18
				Sambam	111	11
				Chori	87	9
				Fai	89	9
				Dura	92	9
				Daddu	49	5
Sub-total					609	61
Birnin Gwari	Chikun	43	4	Nasarawa	153	15
				Kakau	151	15
				Rido	133	13
				Jabo	97	10
Sub-total					534	53
Total	**4**	**205**	**20**		**2,580**	**258**

Source: Reconnaissance survey, KADA 2018

The fourth LGA, was purposively selected from the last zone (Birnin Gwari) because of the security challenges in the area. This gives four (4) LGAs. The 10 of villages were selected randomly. Finally, the random selections of 10% of the sample frame were selected randomly from each village to obtain 258 maize farmers out of 2,580 using the balloting system.

Method of Data Collection

The study used primary data obtained with structured questionnaire administered to the selected maize farmers in 2017/2018 farming season. The data obtained from the maize farmers

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include farmers' socio-economic characteristics and production information especially inputs used and output of maize production.

Analytical Techniques

Data collected for this research were analysed using the descriptive statistics, Tobit regression model and food security index (FSI). FSI was used to determine the food security status of maize farming household. To measure household food security, a food security index was constructed which involves two steps: identification and aggregation procedures. Identification is the process of defining a minimum level of calorie consumed necessary to maintain healthy living. This is referred as the 'Food Security Line", below which households are classified as food insecure while aggregation was used to derive food security statistics for the households. The food security line used in the study was based on the calorie consumed daily. The food security line was estimated using the formula:

$$Z_i = \frac{X}{Y} \quad \ldots (1)$$

where;

Z_i = food Security Index,

X = per capita calorie available to a household per day,

Y = recommended per capita calorie intake per day.

For a household to be food secure Z_i must be greater than or equal to 1 ($Z_i \geq 1$). If Z_i is less than 1 ($Z_i < 1$), the household is food insecure. Thus, a household will be food secure if its calorie food intake is more than or equal to Z_i and food insecure if otherwise. For the purpose of the study, a farm household is a group of individuals who live together and eat from the same pot.

The quantity of crops produced and purchased for consumption was converted to kilogram and then to calorie and then divided by the adult equivalent household size, using the Food and Agriculture Organization (FAO) adult equivalent scale. To estimate the calorie consumed per day per household, the result was further divided by 365 days and then compared with the FAO standard (2260 Kcal) for food secured individual. The households whose daily per capita calorie was up to 2260 Kcal were regarded as food secure, while those below the food security line of 2260 Kcal were regarded as food insecure.

Tobit model was used to determine the effect of maize production on food security of maize-farming household. Two stages of analyses were involved; firstly, a food security index (FSI) was constructed to serve as dependent variable and secondly, the Tobit regression model was used as a lead model to estimate the effects of maize production on food security status of the maize farmers.

$$Y_i = X_i\beta + \varepsilon_i \quad \ldots (2)$$

where;

Y_i = Food security index for i^{th} farming household,

X_i = independent variables which are the factors influencing food security status,

ε_i = the error term and

β = vector of the parameter estimates

The Tobit model is stated explicitly as:

$$Y_i = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + \beta_9 X_9 + \beta_{10} X_{10} + \beta_{11} X_{11} + U_i \quad \ldots (3)$$

where;

Y_i = index of food security for the i^{th} farming household,

X_1 = Yield of maize (Kg)

X_2 = age of household head (years),
X_3 = marital status of household head,
X_4 = education level of household head (years),
X_5 = household size (number of person),
X_6 = farm size (ha),
X_7 = years of farming experience (years),
X_8 = membership of association (dummy)
X_9 = access to credit (₦),
X_{10} = access to off-farm income (₦),
X_{11} = number of contacts with extension agent.

RESULTS AND DISCUSSION

Socio-economic Characteristics of Maize Farmers

The result of the socio-economic characteristics of maize farmers presented in Table 2 showed that the mean age of the maize farming household head was 46 years. This depicts that most of the maize farmers are on average still within the productive and economically active age group. Hence, the farmers are more likely to make positive contribution to agricultural production, and may be more receptive to improved agricultural technologies and management practices. Among the sampled maize farmers, majority of the respondents (92.64%) were married. The significance of high number of married farmers is that there could be more family labour available to farming households to accomplish different farm operations in order to increase their income and standard of living. This finding is in agreement with Sani and Oladimeji (2017) who posited that family labour would be more available where the household heads are married.

Education is an important socio-economic factor that influence farmer's decision making as it influences farmer's awareness, perception and adoption of innovations that can bring about increase in productivity. The result in Table 2 revealed that majority of the maize farmers (76.75%) in the study area had one form of formal education or the other implying that there is potential for increased maize production since literate farmers have better ability and knowledge to access and absorb new information to enhance their productivity. Sani and Oladimeji (2017) noted that level of education to influence farmers' adoption of agricultural innovations and decision on various aspects of farming.

The mean household size of 10 persons suggests that more mouths are to be fed and depend on the income from maize production to be food secured. The significance of household size in agriculture that there is likelihood of reduced cost of labour, as adequate family labour may be available for farming operations.

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Table 2: Socio-economic Characteristics of Respondents

Variable	Range	F	%	Mean	Std. dev.	COV, %
Age	≤ 30	18	6.98	46	10.1	22
	31-40	78	30.23			
	41-50	75	29.07			
	51-60	66	25.58			
	>60	21	8.14			
Sex	Male					
	Female					
Marital status	Single	6	2.33			
	Married	239	92.64			
	Divorced	3	1.16			
	Widow/widower	10	3.88			
Household size	≤5	54	20.93	10.3	6.1	59.2
	6-10	108	41.86			
	11-15	62	24.03			
	16-20	16	6.20			
	>20	18	6.98			
Education level	Non-formal	60	23.26	10.3	6.1	59.2
	Primary	56	21.71			
	Secondary	90	34.88			
	Tertiary	52	20.16			
Experience	≤10	18	6.98	25.3	9.7	38.3
	11-20	82	31.78			
	21-30	107	41.47			
	31-40	33	12.79			
	>40	18	6.98			
Extension	0	194	75.19	4.7	1.5	31
Contact	1-3	14	5.43			
	4-6	14	10.47			
	≥6	23	8.91			
Total		258	100			

Household Food Security Status

The result presented in Table 3 showed that approximately 62% of the sampled households were food secure while 38% were not food secure. The larger proportion of the food secured household could mean that the level of production was high and this could afford them the ability to consume what they produced and sell surplus to buy other things. It may also be that the food secured households engaged in other farming and secondary activities, which enables them to generate additional income to supplement revenue from maize production. This is in agreement with the findings of Onasanya and Obayelu (2016) in their study of determinants of food security status of maize based farming households in southern guinea savannah area of Oyo State, Nigeria.

The food security indices for the food secure and insecure households estimated to be 1.84 and 0.47, respectively, while the food security index for the pooled data was 2.10. The value of 1.84 for the food secure household indicates a surplus of 0.84 among the food secured households. The shortfall/surplus index measures the extent of deviation from the food security

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line. The average total crop output of 8550.68 Kg for the food secure household suggests that these households produce higher output per ha of maize production for them to attain a FSI of 1.84. The average daily calorie consumption for the food secure household was 4165.63 Kcal, and this suggests an excess in calorie consumption of the recommended by 1905.63 Kcal.

On the other hand, the food insecure household with FSI of 0.47 indicates that these households have shortage index of 0.53 (1 – 0.47) for them to be food secured. The average daily calorie consumption of 1069.38 Kcal shows a shortage in calorie consumption of the FAO recommended by 1163.62 Kcal. Analysis further revealed that the average farm and non-farm income, which is a key determinant of households' food security status, was estimated to be ₦230,654.90 and ₦685,197.50 for food insecure and food secure household respectively. The results corroborate the findings of Oyewole (2012) of food security measurement and income diversification strategies in Oyo State where 66.4 % and 33.6 % of the sampled households were food secure and food insecure, respectively. Result is also in tandem with findings of Keku (2017), where he found majority (66 %) of sample farm households to be food secure in Kaduna State.

Table 3: Summary of Households' Food Security Analysis

Variable in Average	**Value [(₦)/%]**
Food secured households (Number)	161
Food security index	1.84
Surplus index	0.84
Average household daily calorie consumption (Kcal) for food secured household	4165.63
Average calorie consumption in excess of recommended (2260Kcal)	1905.63
Average total crop output for food secured households(kg)	8550.68
Average total income of food secured household (₦)	685197.5
Percentage of food secured household	62.40%
Food insecure households (Number)	97
Food insecurity index	0.47
Shortage index	0.53
Average household daily calorie consumption (Kcal) for food insecure household	1069.38
Average calorie consumption in shortage of recommended (2260Kcal)	1163.62
Average total crop output for food insecure households(kg)	1560.77
Average total income of food insecure household (₦)	230654.9
Percentage of food insecure household	37.60%

Level of Food Security among Maize Farmers

The result presented in Table 4 further showed the different levels or categories of food security status among maize farmers in Kaduna State. The calorie intake shortfalls are estimated based on the nutritional food security line of 2260 Kcal. According to Meseret (2012), the level of food insecurity measures the calorie consumption according to the degree of severity of food insecurity. The result in Table 4 shows that a proportion (62.4 %) of the maize farming households were found to be food secured suggesting that these households show zero evidence

of food insecurity, whereas the other 37.6 % were found to be food insecure with different severity levels. The result showed that about 28.7% were severely food insecure, while 4.3% and 4.7% were marginally and moderately food insecure respectively. The result supports the findings of Ojeleye (2015), where larger proportion (66.4 %) of the sampled households was be food secured.

Table 4: Distribution of Maize Farmers Based on Level of Food Security

Food security levels	Calorie consumption per person per day	Frequency	Percentage
Food secure	Above 2260 Kcals	161	62.4
Marginally food insecure	Between 1800 and 2260Kcals	11	4.3
Moderately food insecure	Between 1500 and 1800Kcals	12	4.7
Severely food insecure	Below 1500Kcals	74	28.7
Total		258	100

Effect of Maize Farming on Food Security Status

The result presented in Table 5 showed the Tobit regression estimates of the effects of maize production on households' food security status. The estimated F-value (F = 102.44 and Prob.>F = 0.000) rejects the null hypothesis that the explanatory variables do not have significant effect on farming households' food security. From the result, out of the 12 independent variables used in the model, six (6) variables significantly affected the food security status of the maize-farming households. The variables are level of food security (P<0.01), output of maize (P<0.01), age of household head (P<0.01), household size (P<0.01), farming experience (P<0.01) and off-farm income (P<0.10). Maize output had a positive relationship with food security status of the maize farmer households. A unit increase in maize output will lead to an increase in household food security by 0.0002 units. This was due to the increase in calorie produced when output increases as households consume what they produce and may sell the surplus to buy back additional food items needed to consume but, not been produced. This is in agreement with the findings of Onasanya and Obayelu (2016); and Sani and Oladineji (2017) who found that maize output had a positive relationship with food security status of the maize-farming households.

Result also revealed that age of the household head has a negative coefficient therefore was found to have an inverse relationship with food security status of the households. A unit increase in age of household head will reduce the probability of household to be food secure by 0.034 units. This could be due to the fact that households with younger heads were more likely to be innovative, engaged in multidimensional livelihood strategies and consequently more food secure than their elderly counterparts (Tekle and Berhanu, 2015).

The coefficient for household size was negative thus, larger households were associated with chances of being food secure. An increase in household size will lead to a decrease in food security of that household by 0.106 units. This result is in line with the *a priori* because increase in the member of households translates to more people feeding from the same resource base and this may lead to household members not being able to assess enough food when compared to situations of smaller household sizes thereby reducing the probability of the household to be food secure. This finding is consistent with study of Nkomoki *et al.* (2019) that found a significant and negative relationship between household food security and household size.

Farming experience has a positive coefficient. A unit increase household's head farming experience increases the probability of that household to be food secure by 0.015 units. This

agrees with the *a priori* expectation because over the years of farming, farmers gain more experience, improve their level of expertise and productivity, thus leading to production of more food for their households. This resonates with the findings of Obasanya and Obayelu (2016); and Oluyole and Taiwo (2016) who stated that farming experience increases productivity, thus leading to food security.

Off-farm income a proxy to wealth was significant and positively related to food security. A unit increase in off-farm income will increase food security by 0.000000125 units. This showed that additional income though having a low value, significantly increased households' probability of being food secured. This is in line with *a priori* expectation as income generated from non-farm sources can be used to improve the purchasing power of households. This result disagrees with the findings of Ahmed *et al.* (2019) who found off-farm income to be insignificant in affecting household food security.

Table 5: Effects of Maize Production on Food Security Status

Variables	**Coefficient**	**Std. error**	**Z**	**P > Z**
Constant	2.939	0.383	7.68***	0.000
Food security levels	0.621	0.116	5.36***	0.000
Maize yield	2.01E-4	1.6E-5	12.83***	0.000
Age	-0.034	0.006	-5.52***	0.000
Marital status	-0.071	0.065	-1.090	0.276
Level of education	-0.031	0.044	-0.700	0.482
Household size	-0.106	0.013	-8.320***	0.000
Farm size	0.003	0.015	0.200	0.839
Experience	0.015	0.006	2.64***	0.008
Association	-0.083	0.201	-0.420	0.678
Access to credit	0.393	0.375	1.050	0.296
Off-farm income	1.25E-06	5.85E-07	2.140**	0.032
Extension contacts	0.006	0.036	0.160	0.872
Diagnostic statistics				
F(12, 246)	102.44***			
Prob > F	0.000			
Number of observation	258			

Note: Level of significance: ***1%, **5% and *10%

Constraints to Maize Production

The constraints faced by maize farmers in the study area ranked according to their severity (Table 6). Specifically, about 57% of maize farmers reported that inadequate access to credit was a serious constraint to expanding maize production in the study area. This implies that difficulty in securing loans due to high interest rates, inadequate loan amounts and collateral requirements by the banks are some of the major reasons to low access to credit in the area. Credit is very strong factors are needed in an agricultural production enterprise and its availability could determine the extent of production capacity and food security status of farming households. It agrees with the findings of Nasiru (2010), who noted that access to credit could have a prospect in improving the productivity of farmers and contributes to improving the livelihood of rural farming communities. Food insecurity exists when people have

inadequate access to capital to produce food leads to insufficient amount of safe and nutritious food required for normal growth and development of healthy life (Keku, 2017).

Inadequate storage facility accounted for about 40% of identified constraints of maize production in the study area. The provision of storage and processing facilities is very important for sustainable maize production as the method of storage in the study area was observed to be traditional in nature. Pest and disease attack accounted for 25% of the constraints to maize production in the study area. Crops are susceptible to attack by numerous insects and diseases throughout the life cycle which were responsible for pre-harvest and postharvest losses. Therefore, effective control of these is since pest and disease automatically causes a serious decline in quality thereby leading to a reduction in product price. About 28% of the respondent has ranked inadequate extension contact as third constraint and this greatly limits their access to new and improved technology.

Table 6: Constraints to Maize Production

Constraints	Frequency*	Percentage	Remarks
Poor seed variety	58	22.5	5th
Low market value	36	14.0	8th
Inadequate access to credit facilities	148	57.4	1st
Low info on improved tech/extension service	72	27.9	3rd
High cost of labour	44	17.1	7th
Inadequate capital	50	19.4	6th
High cost of inputs	35	13.6	9th
Pest and insect attack	64	24.8	4th
Inadequate storage facility	104	40.3	2nd
Others	31	12.0	10th

* Multiple responses existed

Poor seed variety accounted for about 23% of identified constraints to maize production. Seeds of high quality are scarce in the study area therefore, farmers use local and unimproved varieties of seeds for production. This finding agrees with Ekong (2003) who opined that most farmers have little or no access to improved seeds and continues to recycle seeds exhausted, after generations of cultivation. The results also show that about 19% of the maize farmers ranked inadequate capital as sixth constraint. High cost of labour ranked seventh with about 17% of the farmers, while low market value and high cost of input were ranked 14 and 13.60%, respectively, as eighth and ninth constraints identified by farmers in the study area. This finding agrees with that of Odoemenem and Inakwu (2011) who observed that high cost of farm inputs, inadequate capital and government interference, inadequate transportation facility inadequate storage/processing facilities and inadequate rainfall were among the constraints faced by farmers.

CONCLUSION AND RECOMMENDATIONS

From the findings, the study concluded that the respondents have a mean household size of 10 members per households. Approximately 62% of the maize farming households were food secure while 38 % were not food secure. About 29%, 5% and 4% of the maize farmer households in the study area were severely food insecure, moderately food insecure and marginally food insecure, respectively. The level of food security, output of maize, age of

household head, household size, farming experience, and off-farm income were found to be significantly affecting the food security status of the maize-farming households. Consequent to the findings, the study made the following recommendations:

1. Coefficient of household size was statistically significant and negative. The higher the household size, the higher the number of mouths to be fed and this directly affects food security status of faming household, sensitization programs on family planning should be conducted with the sole aim of controlling birth to numbers they can cater for.
2. Poor access to credit, inadequate storage facilities and inadequate extension contact were the major constraints to maize production. Therefore, cooperative societies should be encouraged among maize farmers. This will enable the farmers' group to have increased access to credit, access to modern farming techniques and access to extension agents. Both government and private organizations to avoid post-harvest losses in maize production should provide subsidies on storage equipment. These are essential indicators for increased productivity and efficiency.

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