Productivity Growth and Food Security of Maize Farming Households in Nigeria

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Abstract

The effect of productivity growth on food security among maize farming households in Nigeria was examined in the study. Secondary data from Nigeria's General Household Survey Panel was extracted for 572 maize farming household heads in 2015/16 and 2018/19 waves. Data were analysed using descriptive statistics, total factor productivity growth calculation, Markov probability transition matrix, FGT food security measures and binary logit regression model. On the average, maize farmers were 50 years old with household size of 9 persons and farm size of 1.4ha. Despite a slight increase in productivity growth of 0.9%, most farmers (73.1%) with low productivity in 2015/16 had no productivity in 2018/19. Moreover, most households (59.3%) were food secure in 2015/16, while 52.1% of the households were food insecure in 2018/19. Productivity growth positively influenced the likelihood of being food secure, alongside household size, secondary and tertiary education levels and non-access to credit. Conclusively, productivity growth improved food security among maize farming households in Nigeria. Therefore, food security programmes should emphasise long-term productivity improvement and attainment of secondary and tertiary education, rather than mere basic education. Furthermore, targeting young farmers and improving the production environment of rural areas will enhance productivity growth.

Keywords: Maize farming households, Food security, Productivity growth, Transition.

Introduction

Maize (*Zea mays* L.) is the second most cultivated crop in the world. Over 170 nations produce 1.48 billion metric tonnes of maize on a global harvested area of 249.2 million hectares, with an average yield of 5.1 tonnes/ha (FAOSTAT, 2023). The United States of America, China, China mainland and Brazil are the highest producers, with annual production of 383.9, 272.8, 272.6 and 88.5 million metric tonnes, and yield of 11.1, 6.3, 6.3 and 4.7 tonnes/ha, respectively (FAOSTAT, 2023). Maize is Africa's central cereal staple. About 977.6 million metric tonnes are cultivated annually on 42.5 million hectares with an average yield of 2 tonnes/ha (FAOSTAT, 2023). The wide gap between average global yield and Africa's yield shows that low maize productivity prevails across the continent. Nigeria's national yield of 1.6 tonnes/ha trails further away from the global average, portending poor maize productivity in the

country, though it is the country's most important cereal (Raheem *et al*, 2021). It is the highest calories source and preferred above other cereal crops commonly consumed in the country (Okonwu *et al*, 2022). Maize production is mainly by small-scale farmers in Nigeria. Most farmers cultivate maize in combination with other crops thus, are not purely maize farmers. Nevertheless, they are referred to as maize farmers in this study to reflect the production of maize in combination with other crops. They could also be referred to as maize-combo farmers. The ideal savannah vegetation explains why maize is predominantly grown in the northern zones of Nigeria, although the southwestern states of Oyo, Osun, Ondo and Ogun also produce significant amounts. Maize production in Nigeria has increased over the years, although, Nigeria's maize yield ranks 117th in the world with a static average of 2.1 tonnes/ha, indicating that little progress has been made in increasing the country's maize productivity. Further, production declined by 1.6% between 2019 and 2020, while yield declined by 2% in the same period (NAERLS, 2020). The yield has remained low over the last decades (FAOSTAT, 2023). Low maize productivity portends negative implications for the country's food security position.

The Food and Agriculture Organization explained food security as the ready availability of nutritious and culturally accepted food for everyone at every time in the right amount, quality, and diversity (FAO, 2004). At the level of the household, food security was spelt out by the United States Department of Agriculture as existing when all household members have sufficient food all the time for an energetic, hale and hearty life (USDA, 2008). Ironically, farming households especially, smallholder farmers who comprise the bulk of food producers also make up the bulk of food insecure people (Otekunrin *et al*, 2021). The severity of food insecurity is prevalent among Nigerian households up to 57.7% (World Bank, 2019). Food shortages are long-term among rural communities, leading to malnutrition, unpredictable pattern of food accessibility, poor food quality and costly food, which exacerbate the food insecurity and the distress of the rural people (Adeoye *et al*, 2022). Furthermore, hunger and malnutrition have become the leading cause of illness burden, with rising under-five mortality and infection susceptibility (IFPRI, 2016). The plummeting food security remains a key public policy problem in Nigeria. Food demand has outstripped total supply due to country's immense increase in population coupled with low agricultural productivity (Posthumus *et al.*, 2018). The national daily caloric intake of 1730 kcal is substantially below the FAO's recommended minimum daily calorie level of 2260 kcal. (Metu *et al.*, 2016). Furthermore, the population of undernourished people in Nigeria has grown from 12.4 million in 2010 to around 29.4 million in 2020 (FAO, 2020), with worsening circumstances observed in the country's conflict-prone North-East zone. Nigeria ranks 103rd out of 116 nations and scores 28.3% with respect to quality, ability to pay for and access food (Global Food Security Index, 2021).

Maize and its products can be a possible means of combating food insecurity in Nigeria.

Ongoing developments of the crop has reduced the probability of crop failure and may enhance the household livelihood, income, and food security on a long-term basis (Masuka *et al.*, 2017). However, maize crop production in Nigeria is characterised by low productivity. Several local and national programmes and policies by the government have been targeted at improving agricultural productivity. These include: the Maize Aggregation Scheme (MAS) initiated in 2019, Commodity Development Initiative on maize under the Agricultural Promotion Policy (APP) introduced in 2015, the maize transformation program under the Agricultural Transformation Agenda (ATA) initiated in 2011. However, Sallawu *et al*. (2021) and Aboaba *et al*. (2020) asserted that the programmes had little successes, with the poor results largely attributable to the mis-targeting of interventions. Furthermore, government efforts have been mostly short-term, while long-term productivity had not been focused upon by successive governments. Productivity means output per unit input but productivity growth is the sustained increase of productivity overtime, which is the actual determinant of the standard of living in a society (Fakayode *et al*, 2008). At the level of the maize industry, productivity growth is what allows the sector to compete with other sectors for resources.

Comprehensive empirical knowledge of maize productivity growth and its effect on food security is required to properly direct policies of the government in addressing the unceasing low maize productivity and food insecurity issues, especially among farmers. Most studies have dwelt on the determinants of productivity among farmers rather than productivity growth determinants, which are not abundant in the literature. Most existing studies on productivity used the ordinary least squares (OLS) regression model (Ibitola *et al*., 2019; Ukoha *et al*, 2010). They found that farmers' productivity was improved by years of farming experience, labour, land, capital, age, farming experience and household size, whereas age squared (life cycle of farmers), years of schooling and sum of days reported sick had a negative relationship with farm productivity. The effect of farm size on productivity was not conclusive in the literature. The studies neither captured productivity over time nor linked it to the food security of the farmers. The study of Mumba (2019), however, focused on productivity growth as the Total Factor Productivity (TFP) change of maize smallholders in Southern Zambia. The study modeled determinants of TFP change using Pooled Ordinary Least Squares (POLS). The findings showed that plot size, credit access, and owning cattle related directly with TFP change, while the age, family size and drought stress had an indirect relationship with TFP change.

Furthermore, the link between productivity growth and food security is limited in the literature. A proliferation exists in the literature of food security studies and the determinants among farm households using probit and logit regression models (Ogunniyi *et al*., 2021; Olufemi and Oladele, 2021; Ojoko *et al.*, 2021; Opaluwa *et al.*, 2018; Sekhampu, 2013). Results revealed that farmers' experience, sex, household size, total household income, output, distance to the nearest town and family labour

had a direct and significant relationship with food security. Contrariwise, an indirect relationship was found for off-farming activities and hired labour with food security of households, while the influence of household head's age, marital status, education level and farm size was not conclusive in confirming the direction of influence on their food security. Therefore, the literature linking productivity growth to food security is limited, despite the importance of productivity improvement overtime to food security attainment and development of agriculture in Nigeria. Given the important place of maize as a food security crop in Nigeria and productivity growth of maize to achieving the desired food security position, it is imperative to explore the link between productivity growth and food security of Nigeria's maize farmers. Furthermore, the country's significant position as Africa's largest peopled country, makes Nigeria a key factor to the continent achieving the Sustainable Development Goals (SDGs) particularly the second goal on food security attainment. Hence, the important questions in this study were: What is the level of productivity and productivity growth among maize farmers in Nigeria? What proportion of maize farmers transited from being unproductive to productive over time in Nigeria? What are the determinants of productivity growth among maize farmers in Nigeria? What is the level of food security among maize farming households in Nigeria? What is the effect of productivity growth on food security among maize farming households in Nigeria? Therefore, the main objective of this study is to investigate the effect of productivity growth on food security among maize farmers in Nigeria. This will help to design appropriate public policies to address the issues of poor productivity growth and food insecurity, especially among maize farmers.

Material and Methods

Nigeria is the study area, having a population of 211.4 million people (UN Population Fund, 2021), land area of 923,768 square kilometres, agro-ecological zones ranging from southern humid forests to the northern parched savannahs of the country, with the south and north having three geopolitical zones each. The southern geopolitical zones include: South East, South West and South-South zones, while the northern zones are: North Central, North East, North West. About 56.7% of the population are primarily engaged in agriculture (World Bank, 2022). Cereals such as maize, along with root and tuber crops dominate food crop production in Nigeria. The country has a large proportion of maize farmers, high level of food insecurity and low maize productivity level.

Secondary data sourced from Nigeria's General Household Survey (GHS) for the periods 2015/2016 (Wave 3) and 2018/2019 (Wave 4) were used in this study. A sample of 572 maize farming households was extracted that produced complete information in both waves. The data were analysed using descriptive statistics, Total Factor Productivity (TFP) growth calculation, Markov chain model, food security measures of Foster–Greer and Thorbecke (FGT) and logit regression model. The measure of how much output can be produced from a given set of inputs was given

by TFP which represented the productivity of the maize farmers in Nigeria. It is expressed as:

$$\text{TFP} = \frac{P_{it}Q_{it}}{\sum P_{it}X_{it}}$$

Eq. (1)

where: TFP = the *ith* maize farmer's total factor productivity at time t; $P_{it}Q_{it}$ = Total revenue of the *ith* maize farmer at time t; $\sum P_{it}X_{it}$ = Summed cost in naira (₦) of inputs used (X_i) by the *ith* farmer at time t. The inputs used X_i include naira (₦) costs of: X_1 = maize seed, X_2 = labour (per man-day), X_3 = pesticides, X_4 = herbicides and X_5 = tractor hiring, X_6 = ridger hiring, following Ibitola *et al.* (2019). The total factor productivity growth (*TFPG*) was then calculated using TFP in 2015/16 as the base year (TFP_{it-1}), while TFP in 2018/19 was represented as TFP_{it}. Hence, productivity growth was expressed as:

$$\text{TFPG} = \left[\frac{\text{TFP}_{it} - \text{TFP}_{it-1}}{\text{TFP}_{it-1}}\right] \text{x } 100$$

Eq. (2)

In this study, TFPG ≤0 indicates negative or no growth, between 0.01-1.00 indicates low growth, while greater than 1.00 indicates high productivity growth.

The percentage of maize farmers having no, low or high productivity over the time periods between 2015/16 and 2018/19 was achieved using the Markov chain model. Where TFP_1 and TFP_2 were used as TFP in 2015/16 ($TFPI_{t-1}$) and 2018/19 (*TFPI)* year, respectively and shown on a probability transition matrix table, P_{ij}. Following Olaleye et al. (2009), the percentage of maize farming households grouped under each category in the periods 2015/16 and 2018/19 is given by:

$$P(k) = P(0)P_{ij}^{k}$$

Eq. (3)

where: $P(0)$ is the starting probability vector of farmers in 2018/19 for productivity movement (no, low and high productivity); P_{ij} represents the transition probability matrix of maize farmers from *i* to *j* (a given productivity group to another); k is the time period after period which is $P(1)$.

Similar to previous studies (Jerumeh *et al.*, 2019; Oluwafemi *et al.*, 2019), equilibrium in the long-run is reached when there is equality of the number of farmers incoming a given productivity group and the number of farmers exiting another given productivity group. It is expressed as:

$$\text{eP} = \text{e}$$

$$(e_1, e_2, e_3)\begin{bmatrix} P_{11} & P_{12} & P_{13} \\ P_{21} & P_{22} & P_{23} \\ P_{31} & P_{32} & P_{33} \end{bmatrix} = (e_1, e_2, e_3)$$

Eq. (4)

where: e = ($e_1 e_2 e_3$) is the vector of steady-state for a three-state Markovian model; *where* e_1, e_2, e_3 denote the long-term prognosis for no productivity, low productivity and high productivity, respectively.

The food security status of the maize-combo farmers' households was assessed using the FGT food security measures. The food security line was two-thirds of the mean

household food budget per capita (MPCHFE). Food secure households had MPCHFE equal to or higher than the food security line, while food insecure households were below the food security line. Following Foster–Greer and Thorbecke (1986), Sani and Kemaw, (2019) and Ogunniyi *et al.,* (2020), the FGT measure is given as:

$$\theta_\alpha = \frac{1}{N}\left(\frac{z-y_i}{z}\right)^\alpha 1(y_i \leq z)$$

Eq. (5)

where: N = the sum of all sampled households; z = food security line; q = sum of households below the food security line and y_i = monthly household food budget per capita; 1 $(y_i \leq z)$= households with MPCHFE greater than or equal to the food security line; α takes values 0,1,2. The food insecurity headcount (θ_0) denotes the proportion of food insecure households with MPCHFE below the food security line. Food insecurity depth (θ_1) is the proportion of expenditure necessary for food insecure households to climb above the food security line. The severity of food insecurity (θ_2) indicates the additional food expenditure required for a severely food insecure household to move out of severe food insecurity.

Finally, the effect of productivity growth on food security was assessed using the binary logistic regression model. Following Ngema *et al.* (2018) and Agbola, (2014), the implicit model is specified thus:

$$Z_i = \beta_0 + \Sigma(\beta X_{ki})$$

(Eq.6)

where: X_i are parameters that influence the food security status of the household; Z_i is the dependent variable which is dichotomous and denotes the chances of a household being food secure or not (that is, 1 = food secure, 0 = otherwise); β_0 denotes the intercept; β_i are the coefficients of the explanatory variables, X_1 to X_{ki} ($see\ Table\ 1$); and u_i denotes the error term.

Table 1: Variable description, measurement and expected sign

Independent Variables	Measurement	A prior expectation
Productivity growth	1 if TFGP>0, 0 if TFPG≤0	+
Sex	male = 1, female =0	+/-
Age squared	years	+/-
Marital Status	married =1, otherwise =0	+
Household size	Number of persons	+/-
Farm size	Hectares (ha)	+/-
Primary education	Attained primary education =1, otherwise =0	+
Secondary education	Attained secondary education =1, otherwise =0	+
Tertiary education	Attained tertiary education =1, otherwise =0	+
Access to credit	Accessed credit =1, otherwise =0	+
Sector	Living in the urban area =1, otherwise =0	+/-

Results

The socio-economic characteristics of the maize farmers are described on Table 2. The most recent wave of 2018/19 was used to describe the farmers' characteristics. Most of the household heads (89.96%) were male. On the average, farmers were about 50 years old, while most of the household heads (85.49%) were married. Moreover, average household size was about nine persons, and most farmers (87.94%) had at least primary education, while 12.06% did not have any formal education. The farm size was an average of 1.4 hectares, while 52.15% cultivated less than one hectare of land. In addition, most (88.64%) of the maize farmers did not access formal credit, and most (76.22%) were not members of any cooperative group.

Table 2: Description of socioeconomic characteristics for maize farmers

Variable	Frequency	Percentage
Sex	(n=572)	
Male	514	89.86
Female	58	10.14
Age (years)		
18-20	5	0.87
21-30	13	2.27
31-40	108	18.88
41-50	186	32.52
51-60	146	25.52
>60	114	19.93
Mean±SD		**50.41±12.45**
Marital Status		
Married	489	85.49
Unmarried	83	14.51
1-5	109	19.06
6-10	311	54.37
11-15	94	16.43
>15	58	10.14
Mean±SD		**9.01±4.05**
Educational Level		
No formal education	69	12.06
Primary Education	238	41.61
Secondary Education	175	30.59
Tertiary Education	90	15.73
Farm Size (ha)		
<1	304	53.15
1-5	243	42.48
>5	25	4.37
Mean±SD		**1.41±1.47**
Access to Credit		
Yes	65	11.36
No	507	88.64
Membership of Co-operative		
Yes	136	23.78
No	436	76.22

Source: Authors' computations from GHS-P 2018/2019.

SD = Standard Deviation

Productivity growth of maize farmers

The result for productivity growth among maize farmers in Nigeria is shown on Table 3**.** Most (58.59%) farmers experienced no productivity growth between 2015/16 and 2018/19, while 15.04% of the farmers had low growth and about a quarter of the farmers had high productivity growth. The mean TFP growth between the two periods was 0.87%.

Productivity transition of maize farmers

The probability transition matrix for the productivity of maize farmers in Nigeria is shown on Table 4. About 67.77% of the farmers recorded no productivity in 2015/16 and

remained unproductive in 2018/19. On the other hand, 15.83% of the farmers who had no productivity in 2015/6, transited to low productivity in 2018/19, while 16.39% of farmers transited to having high productivity in 2018/19 from no productivity in 2015/16. Furthermore, 73.79% of the farmers that had low productivity in 2015/16 transited to having no productivity in 2018/19, while 10.67% of farmers who had low productivity in 2015/16 transited to high productivity in 2018/19. Finally, half of the farmers who had high productivity in 2015/16 transited to having no productivity in 2018/19, while the other half remained in high productivity in the same period.

Food security estimation of maize farmers

The FGT estimates of food insecurity levels for the maize farming households in Nigeria in 2015/16 and 2018/19 are presented on Table 5. The mean per capita household food expenditure reduced by ₦259.58, hence the food security line declined by ₦173.05 between 2015/2016 and 2018/2019. The food insecurity incidence (θ_0) was 0.4266 in 2015/16 and 0.5209 in 2018/19, indicating an increase from 42.66% to 52.09% in the proportion of food insecure maize farming households in Nigeria. Moreover, in 2015/16, the majority of the households were food secure, while in 2018/19, most were food insecure. Furthermore, the depth (θ_1) of food insecurity among the households in 2015/16 and 2018/19 were 15.46% and 22.54%, respectively. This implies that an average food insecure household needed to increase food expenditure by 22.55% in order to move out of food insecurity in 2018/19 compared to only 15.46% in 2015/16. Finally, severe food insecurity among the farming households in 2015/16 and 2018/19 were 0.08% and 13.43%, respectively.

Table 3: Total factor productivity growth between 2015/16 and 2018/19 among maize farmers in Nigeria

Productivity growth	Frequency	Percentage
Negative and No growth (≤0.00)	334	58.39
Low growth (>0.00– ≤1.00)	86	15.04
High growth (>1.00)	152	26.57
Mean±SD		0.87±1.68
Total	572	100.0

Source: Authors' computations from GHS-P 2018/2019.

Table 4: Markov probability transition matrix of total factor productivity

	No productivity	Low productivity	High productivity	Total
		2018/196		
No productivity	244 (0.67)	57 (0.1)	59 (0.17)	360 (0.63)
Low productivity	152 (0.74)	32 (0.16)	22 (0.11)	206 (0.36)
		2015/16		
High productivity	3 (0.50)	0 (0.00)	3 (0.50)	6 (0.01)
Total	399 (0.69)	89 (0.16)	84 (0.15)	572

Source: Author's computations from GHS-P 2015/16 and 2018/2019.

Table 5: Food insecurity indices of maize farming households

	Food insecurity incidence	Food insecurity depth	Food insecurity severity	Food insecurity line (two-thirds of MPCHFE) ₦	Mean per capita household food expenditure (MPCHFE) ₦
2015/16	0.4266	0.1546	0.0772	3843.01	5764.52
2018/19	0.520979	0.22547	0.134381	3669.96	5504.94

Source: Authors' computations from GHS-P 2018/2019.

Effect of productivity growth on food security of maize farmers

The logit regression estimates for the effect of productivity growth on food security for Nigeria's maize farming households are shown on Table 6. The model summary shows the chi-square value of 80.71% and adjusted R^2 value of 24.52, with the chi statistics significant at 1%. Hence, there is statistically significant relationship between the variables, though only about a quarter of the variation in food security is explained by the independent variables. This suggests that the food security status of the farmers is sufficiently explicated by the independent variables. The variables that were found to influence food security include: productivity growth, marital status, household size, secondary and tertiary education level, access to credit, and living in the South-west, South-south, South-east, North-west and North-east zones. Productivity growth squared had a significant direct relationship with the likelihood of being food secure. Hence, as productivity growth increases overtime, it is more probable that maize farming households will be food secure by 0.01%. Likewise, marital status had a direct relationship, with statistical significance at 10% level. This shows that the chances of being food secure is increased by 32.5% when the household head is married, relative to being unmarried. Moreover, household size related positively with food security, meaning that the chances of being food secure is increased by 2.38% when a maize farming household size increases. The secondary and tertiary education levels of the household head related positively with food security, hence, the chances of being food

secure was increased by having secondary and tertiary education. On the contrary, access to credit had an inverse relationship food security. Thus, having access to credit decreased the chances of being food secure by 18.15% for a maize farming household.

Table 6: Logit regression estimates for the effect of productivity growth on food security

Variable	Coefficient	Std. Error	P>|z|	dy/dx
Productivity growth sq	0.0007*	0.0004	0.057	0.0001
Sex	0.4736	1.2961	0.715	0.0829
Age sq	-0.0001	0.0002	0.689	-0.0004
Marital status	1.8572*	1.0133	0.067	0.3250
Household size	0.1358***	0.0468	0.004	0.0238
Farm size (ha)	-0.0978	0.1099	0.374	-0.0171
Primary educational level	-0.2729	0.5187	0.599	-0.0455
Secondary educational level	0.9786*	0.5119	0.056	0.1763
Tertiary educational level	2.4287***	0.6618	0.000	0.4086
Access to credit	-1.0368*	0.6202	0.095	-0.1815
Sector	0.8681	0.6687	0.194	0.1453
Constant	-5.4885	1.3962	0.000	

Source: Authors' computations from GHS-P 2018/2019. ***, **, * indicate significance at 1%, 5% and 10% respectively

Discussion

The male dominance in maize farming may be attributable to traditional roles and the rigorous methods used. This aligns with Fadare *et al.* (2014), who found that males make up the majority of maize farmers in Nigeria. The age of the farmers indicated that most farmers were in their productive years though youths' participation in maize farming is relatively low. This is consistent with the findings of Kehinde and Tijani (2021) who also found that most farmers were in their active and productive years. The observation on household size showed that maize farming households in Nigeria are fairly large. This could have positive implications for maize farmers with respect to use of family labour for their farm operations. This is similar with the findings of Zongoma *et al.* (2015). Most household heads were somewhat formally educated and could adopt agricultural innovations to aid productivity and enhance food security status. This agrees with Girei *et al*. (2018). Furthermore, small-scale farmers dominate maize production in Nigeria. This agrees with Saleh *et al*. (2018), that maize farmers in Nigeria are small holders. Additionally, the case of access to formal credit showed that finance was sourced from personal savings or other informal sources. The high cost of borrowing, need for collateral, and lack of knowledge about available credit facilities may

account for this. The findings of Gershon *et al.* (2020) agree that most farmers in Nigeria have no access to credit. Similarly, most maize farmers are not members of any cooperative group, implying that only a few farmers enjoy the benefits of membership such as access to credit and high-quality production inputs provided by cooperatives. This aligns with Onuk *et al.* (2010) and Ajah and Nmadu (2012).

The low productivity growth among maize farmers indicates low growth in maize productivity overtime in Nigeria. Adedeji *et al*. (2017) also found positive growth in crop productivity over a 54-year period for Nigeria. Positive yet low growth may not be adequate to achieve the desired level of development for the sector. This has implications for the effectiveness of policies on agricultural productivity in Nigeria. Thus, past policies may have achieved some level of growth which may be insufficient to bring about significant and appreciable development of the sector.

The productivity transitions indicates that only a modest improvement in maize productivity occurred between 2015/16 and 2018/19, while most farmers remained unproductive. This further indicates that most maize farmers experienced worsening productivity levels relative to those that experienced improvements. This agrees with the FAO (2022) report that Nigeria's agricultural productivity has been stifled owing to several issues of agricultural policy and development such as: land tenure issues, poor irrigation farming, climate change and land degradation.

Rising food insecurity among maize farming households in Nigeria is not expected since farmers are food producers, hence should be food sufficient and food secure. Productivity growth overtime expectedly relates directly with food security. Productivity growth is predictable to increase farm incomes and ultimately improve food security. Likewise, a married household head has the responsibility of satisfying its family food demands, relative to an unmarried one. Although, household size and food security was not expected to relate directly, a large household could translate to more family labour available to produce more food which ultimately improves food security. This agrees with the study by Maitra and Rao (2015). With respect to education, the positive relationship between secondary and tertiary education levels of the household is plausible since education enhances the farming skills and productive capabilities of the farmers. This finding is consistent with that of Irohibe and Agwu (2014). The credit constrains faced by many smallholders may be responsible for the inverse relationship found between access to credit and food security, which was contrary to expectation. Only a fraction of the loan required or applied is often released to farmers, leading to incapacity to gain expectedly from the credit obtained. This agrees with the findings of Afolabi *et al* (2021), who concluded that loans do not significantly influence food security.

Conclusion

The effect of productivity growth on food security of maize farmers in Nigeria between the periods 2015/16 and 2018/19 was investigated in this study. It was established that on the average, maize farmers had low productivity growth between both periods.

Most maize farmers either remained unproductive in both periods or transited from being productive in the 2015/16 to being unproductive in 2018/19. The factors that impeded productivity growth of the farmers were: age, membership of cooperatives and living in the rural area, whereas being male and farm size improved productivity growth. Moreover, the levels of food security among the maize farming households worsened between 2015/16 and 2018/19. It was concluded that productivity growth improves food security among Nigeria's maize farming households, alongside household size, secondary and tertiary educational levels, and non-access to credit. Therefore, food security interventions by the government should include a long-term plan to improve productivity growth of farmers in Nigeria. Finally, education interventions for farmers should go beyond the basic level, which is the current drive of the Nigeria government. Policy should focus on education up to secondary and tertiary levels, as these levels improve food security among maize farming households.

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