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AGRICULTURAL PRODUCTION CHALLENGES AND SMALLHOLDER FARMERS' FOOD SECURITY IN SOUTH-SOUTH GEOPOLITICAL ZONE OF NIGERIA

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ABSTRACT

Food is a necessity for human survival, yet food insecurity remains a major global challenge, particularly in Africa, and for the poor, many of whom are farmers, and operating at subsistence and small-scale commercial. This study assessed the food security status of smallholder farmers and examined the association with the challenges limiting their agricultural production in southern Nigeria. A mixed-method research approach involving survey and participatory focus group discussions was employed in the study. The primary data collected from across six States through a multistage sampling procedure, were analysed using descriptive and inferential statistics. The Food Insecurity Experience Scale (FIES) was used to categorize the farmers' food security status. Results showed significant differences in food security across the States, age groups and education attainment level. Farmers experienced the challenges of difficulties in accessing better markets, improved crop varieties, access to and participation in extension service programmes, pest issues and adequate loans accessibility among others. Significant differences were observed between the farmers at different levels of food security status and some of the identified major production challenges, indicating their potential influence. Therefore, to sustain agriculture production and ensure food security of the farmers, there is a need to develop all-encompassing plans that incorporate production inputs and market access, enhance social capital development, and improve funding for agriculture. All of that could enhance the general resilience and well-being of southern Nigerian rural communities and particularly addressing food security challenges among smallholder farmers. The study also suggests increasing food security awareness, particularly among the older-age farmers, and further research on investigating the cause of disparities in the observed food security status of the farmers for improved productivity and wellbeing. Thus, the findings of the study contribute actionable information for identifying vulnerable groups and guiding policy formulation that aligns with Sustainable Development Goals 2 (Zero Hunger) and 3 (Good Health and Well-being), ultimately giving a voice to those experiencing food insecurity.

Key words: Agriculture, food security, productivity, challenges, factor analysis, farmers, households, smallholders

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INTRODUCTION

Agricultural productivity is an important aspect of food security, and as noted in literature, higher agricultural production leads to increases in food availability and income that enable the farmer to purchase a wide variety of food items (food accessibility) and to meet other basic needs like health care and education [1]. An increase in agricultural productivity may help developing countries escape from poverty [2]. Although, in the short and medium term, given Engel's law, the percentage of income spent on food decreases as income rises, an individual or household's total expenditure on food might increase due to more money being available for food consumption [3]. Thus, agriculture linkages to food security are important for many farm households in low- and middle-income countries, particularly those confronted with climate change impacts and soil degradation [4]. No doubt, smallholder farmers often prioritize household food production, which is crucial for sustaining their labour-intensive work and ensuring a consistent food supply [5]. Therefore, limiting challenges hindering agricultural production is a key driver for improving food availability and food access as well as food stability among smallholder farmers [3].

Nigeria, like many other developing nations, faces increasing food insecurity and malnutrition. The country's ranking on the Global Hunger Index (GHI) dropped from 101 in 2015 to 109 out of 125 countries in 2023, indicating a deteriorating situation [6]. This is an alarming trend that highlights the need for stakeholders to prioritize activities that directly or indirectly address the problem of food insecurity. Food security is considered multidimensional, broadly consisting of food availability, access, utilisation and stability [7]. Where limitations are experienced, and any one of the dimensions negatively affected, it leads to adjustments in food consumption pattern and expenditure, resulting in poor nutrition. Food security promotes good health and labour productivity [8]. In the context of this study, food availability and access are important for smallholder farmers who often depend on their own farm produce.

The study draws from the theory of the Agricultural treadmill developed by Cochrane [9] and Schultz's theory of traditional agriculture [10]. The agricultural treadmill theory expresses that early adopters of improved technology will initially, enjoy production increases, lower cost of production and increased earnings until increased production leads to falling prices which creates a compelling need for farmers to adopt new technology to remain competitive [9]. In addition, Schultz theory of traditional agriculture argues that traditional agricultural practices are constrained by limited access to improved technology, modern inputs and credit; subsequently emphasizing on modernization of agricultural practices by improving

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access to modern inputs, improved knowledge, skills and education to address the challenge of low productivity [10]. Agricultural productivity contributes to a farmer's nutrition security as well as being a function of the farmer's managerial capability or wellbeing and which can be impaired by malnutrition. There exist, studies that focus on the availability and accessibility aspects of food security with reference to farmers' production surplus for markets, and households' purchasing power and food channels, respectively across gender and different geographical locations such as Kenya, India, South Africa and Nigeria [11,12,13,14]. However, there are still important gaps that call for further study, especially in the smallholder farming communities of the south-south geopolitical zone of Nigeria. Agriculture in this geopolitical zone is overwhelmingly for subsistence and, the farmers mostly cultivating on less than 2 hectares of land. The farmers are faced with numerous challenges that include flooding, inability to access land for increasing production, environmental degradation and loss of livelihood caused by oil pollution, crop pest and disease, poor infrastructure, inadequate extension service provision and farmers-herders' conflicts among others [15,16].

Despite the importance of agricultural production, the complex socioeconomic, environmental factors and unique difficulties encountered by smallholder farmers who make up a sizable section of the population in southern Nigeria are not given enough attention. Previous food security studies on Nigeria have focused on certain States or areas, including the southwest or north-central regions [17, 18]. Studies that are particular to a certain location are required because of regional differences in agro-ecological conditions, socioeconomic issues, and cultural traditions, which may affect levels of food security. Some studies have examined the effect of livelihood diversification (on-farm and off-farm diversification) on food security with focus on gender including women farmers [12,19]. Other studies have focused on determinants of crop productivity and the effects on food security of rural and farming households [13, 20]. Thus, the main contribution of this study to existing literature is to generate more evidence using large data, of the relationship of agricultural production challenges faced by smallholder cassava and yam-based farmers and their food security status in the south-south geopolitical region of Nigeria. The findings will contribute actionable information for identifying vulnerable groups and guiding policy formulation that aligns with Sustainable Development Goals 2 (Zero Hunger) and 3 (Good Health and Well-being), ultimately giving a voice to those experiencing food insecurity.

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MATERIALS AND METHODS

Location of the Study

The study area was the six States of south-south Nigeria, namely, Akwa Ibom, Bayelsa, Cross River, Delta, Edo and Rivers state. Figure 1 shows the location of the six States on the Nigerian maps. The dominant agricultural activities in the States are fishing and crop farming, including subsistence food crops and cash crops [21]. Also, poultry, pigs, sheep, goats, and rabbits are raised across the States, and people across the States also engage in shrimping along the coast and deep-sea fishing. The south-south geopolitical zone was chosen for the study as the zone is known for the predominance of cassava and yam production.

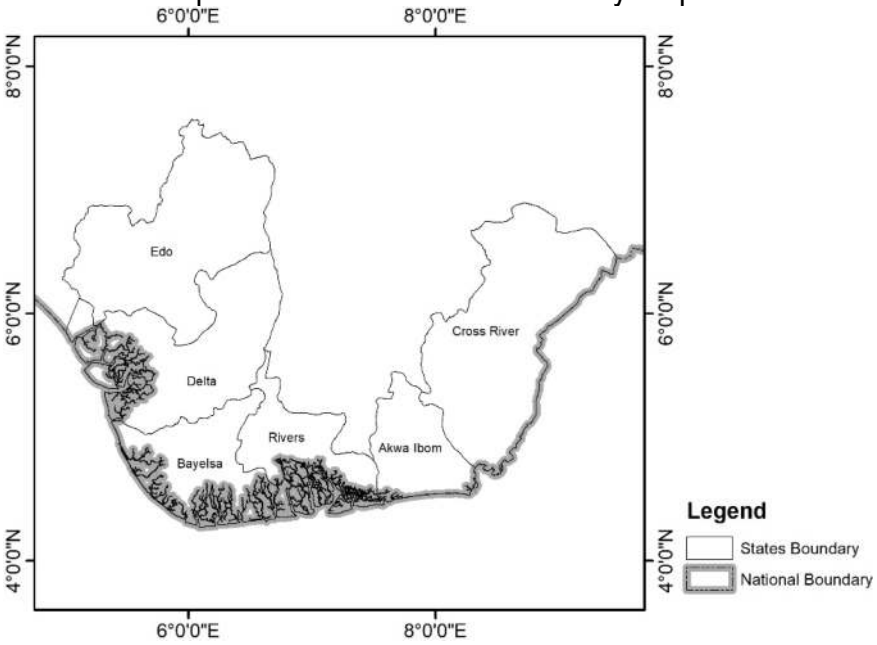

Figure 1: Map showing survey locations
Source: Author's illustration (2023)

Sample size and sampling technique **-** The study population consists of all farming households involved in cassava and yam production in the six states of south-south Nigeria. Cassava and yams are staple food crops mostly cultivated by smallholder farmers, playing a vital role in ensuring food security and generating income [22]. Cassava and yams are vital sources of carbohydrates in Nigeria, serving various purposes from direct consumption to industrial raw materials [23]. The sample size was computed using the Yamane sample size computation formula [24]. A total sample size of 2,397 farmers was surveyed proportionately according to the population of farming households across the communities of the six States [25]. The survey distribution is seen in Tables A1 and A2 in the appendix. However, responses were only retrieved from 2,368 farmers, a 98.8 % response rate.

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Sample size formula

$$n = \frac{N}{1+N\,(e)^2} \quad (1)$$

Where *n* is the sample size of each State, *N* is the sample frame (population) of each State, and *e* is the precision level or error of the sample (taken as 0.05). While determining the number of questionnaires to be distributed in each state, the following formula was used.

$$n_h = n\frac{N_h}{N} \quad (2)$$

Where, n_h is the proportionate sample size to be surveyed from individual State, N_h is the population of crop farming households in each State, *n* is the total sample size (as computed from the Yamane formula above), and *N* is the total population of crop farming households in all the States.

Data collection and analysis

The study engaged a mixed-method research approach involving survey and participatory focus groups. A multistage sampling procedure was employed in data collection. In the first stage, two farming zones were chosen from each of the six states, making 12 agricultural zones. In the second stage, two local government areas (LGAs) were chosen from each zone to make 24 LGAs and in the third stage, two communities known for production of cassava and yam in high amounts were chosen from each local government area making a total of 48 communities from which farmers were surveyed through systematic random sampling. Data were collected through the administration of questionnaires alongside interview. Prior to conducting the full survey, informative and participatory focus group discussions were held with selected farmers across the States to gain an in-depth understanding of farmers' knowledge of agricultural production particularly with respect to cassava and yam and how farmers perceived the relationship between their production and food security status. The FGD which was facilitated by an interview guide provided an opportunity to educate farmers on the concept of food security and improved technology for the selected crops. Farmers' response statements were summarised through thematic analysis. Quantitative data were analysed using a combination of descriptive and inferential statistics using the Statistical Package for the Social Sciences (SPSS) version 26.

Assessment of food security among the farmers

Food insecurity experience was used as a proxy for food security among the farmers. One commonly used metric for evaluating the severity of food insecurity is the Food Insecurity Experience Scale (FIES) developed by the Food and Agriculture Organization (FAO) [26, 27]. The FIES, which is made up of a set of eight questions

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with a "Yes or No" response presented in Table 1 can be used on a one- or twelve-months reference period. It indicates a continuum of the extent of food insecurity experience, ranging from mild to severe insecurity questions. The sum of affirmative responses to the questions is used to calculate a raw score that determines the food security status of an individual [28]. Based on the FIES framework, the raw scores could be used to categorise the farmers into four groups. A farmer scoring between 0 – 2 is considered food secure whereby most of the food insecurity features were not experienced, 3 - 4 (mildly food insecure), 5 - 6 (moderately food insecure) and a score of 7 – 8 meant that the farmer is severely food insecure. However, for a few noticeably high correlations among the FIES statement (see Table A3), a Principal Component Analysis (PCA) is employed to compute a Food Security Index (FSI) with help of Stata 16.0 and the index was used to categorise the farmers into two groups (food secured and food insecure) and the index scores further used as a dependent variable regressed on selected socioeconomic variables.

Identifying challenges militating against farmers' agricultural production

Factor Analysis: The principal component factor analysis model is stated thus:

$$Y_{ij} = a_{i1}x_{1j} + a_{i2}x_{2j} + * * * + a_{in}x_{nj} \quad (3)$$

where, Y_{ij}, is the component score for challenges in agricultural production, $a_1 – a_n$ is the component loadings or correlation coefficients, and $x_1, x_2, \ldots x_n$ are unobserved factors underlying challenges in food production. The factor analysis through varimax rotation of the axis defined by PCA extracts a new group of variables known as varifactors [29].

Reliability test - The results of the reliability test showed a Cronbach's Alpha score of 0.6 for 14 items listed as factors influencing farmers' agricultural production. The reliability score shows a moderate level of reliability, which is also acceptable. The score was expectedly so as the items were categorical (Yes/No) and not of an interval measure. The reliability test score is an indication that the instrument (questionnaire items) used in collecting data was good and would reliably give consistent outcome.

RESULTS AND DISCUSSION

Prevalence of food insecurity experience across selected demographics

The farmers were categorised into two groups based on the computed FSI values which ranged from -1.592 to 0.628. Since the FIES questions indicate that higher affirmative responses are indications of worsening food security, it therefore meant that higher values of the FSI represent a state of food insecurity and lower values indicated otherwise. Thus, a cut-off mark was established such that values less or equal to -0.963 were classified for a farmer as food secured, otherwise food

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insecure. It could be seen from the results presented in Table 2 that smallholder farmers in the six southern Nigerian States exhibited an alarming degree of food insecurity. Bayelsa State (87.7 %) and Edo State (77.2 %) had the highest percentages of farmers who are food insecure. This implies a need to address the root causes of food insecurity in these States. Earlier studies have shown significant incidences of food insecurity in several parts of Nigeria, especially among rural families [30,31]. The highest share (47.5 %) of food-secured farmers was observed in Akwa Ibom State, whereas the highest share of food-insecure farmers was found in Bayelsa State. The Pearson Chi-square test revealed statistically significant differences in the experiences of food insecurity among farmers given their location (χ^2 = 133.1; p < 1%); age (χ^2 = 18.4; p < 1%), education (χ^2 = 126.5; p < 1%) and earning off-farm income (χ^2 = 4.5; p < 5%). This implies that these variables, given their different conditions, may be underlying causes of food insecurity.

The highest share of the food insecure farmers was observed among older-age farmers (> 71 years) followed by those younger than 53 years. This finding is in line with earlier research that suggested older households may have a number of challenges that increase their susceptibility to food insecurity [32]. Also, more food insecure farmers had some form of education. A greater share (80.1%) of those without formal education were more food insecure than farmers with one form of education. Higher education levels have the potential to improve off-farm job prospects in certain situations, which might reduce the time and resources spent on agricultural operations, reduce dependency on farm produce and have an influence on food security [33]. Furthermore, a higher share (29.7%) of food-secured farmers possessed non-farm or off-farm income streams, which can act as a safety net against agricultural hazards and generate additional revenue.

Production challenges faced by farmers in the study area

The results of the PCA-factor analysis are presented in Table 3. They showed that twelve out of the fourteen items form the basis for assessing farmers' production challenges and association with their state of food security. Factor loadings that are greater than 0.75, between 0.50 and 0.75, and between 0.3 and 0.5 are considered to be strong, moderate and weak, respectively [29]. Thus, in this paper, variables that have factor loading of less than 0.30 and/or that loaded in more than one factors are rejected. The analysis gave six factor loadings based on Eigen values greater than one, each factor representing a cluster of related constraints. The factors are grouped into economic/institutional, techno-infrastructural and socio-financial factors as used in Amusa *et al*. [34]. The Eigen values and percentage of variance explained indicate that these factors collectively account for about 66.3% of the variability in the agricultural challenges perceived or experienced by the farmers. Additionally, the Kaiser-Meyer-Olkin measure of sampling adequacy (0.66) and Bartlett's test of

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sphericity ($p < 0.001$) suggest that the data are suitable for factor analysis, indicating the appropriateness of the model.

Factor 1: Economic/institutional (Access to market, improved varieties, and adequate loans)

The first factor, which accounts for 17.7 % of the total variance and has an Eigen value of 2.48, highlighted constraints that are related to access to market and access to funds. This factor includes variables with factor loadings between 0.67 and 0.79, indicating moderate to strong positive loadings. Also, the positive values imply that the variables vary together. For instance, an increase in farmers' inability to access better markets for higher income could lead to an inadequacy of funds that increases farmers' inability to access improved varieties for higher yield. The constraints represented by this factor align with the results of previous studies that provide evidence of the significance of market accessibility for smallholder farmers. As observed in a study of market access in Kenya, limited market access might make it more difficult for farmers to sell their goods and make a living [35]. Market access was found to play a crucial role in determining the pathways from agricultural technology adoption to improved nutrition status among rural households in Tanzania [36].

Factor 2: Social capital/participation in extension service programs

This second factor accounts for 16.2 % of the total variation and has an Eigen value of 2.3. It is related to farmers' membership of farming organisations, participating in organised extension service programs and having access to credit. This factor, however, has moderate to strong variable loadings (0.72 - 0.80). Being structured together as a group or association and participating in extension service programs provides a platform for farmers to interact, exchange ideas, and learn about new technological practices that have been tested to be beneficial and also, enhance their access to credit and other farm inputs that may be distributed through organisations. The lack of agricultural extension services can be a barrier to increased agricultural productivity and food security among smallholder farmers. For example, it has been documented that improving rural food security and lowering seasonal variations in dietary variety among smallholder families in Malawi required access to financing and extension services [37].

Factor 3: Economic (constraints of inputs of chemicals and fertilisers)

The third factor, which accounts for 9.00 % of the total variance and has an Eigen value of 1.26, encompasses constraints related to accessibility and application of chemicals and fertilisers that can help to boost production levels. This factor includes variables with factor loadings greater than 0.75, indicating a strong influence of the variable loadings. These results imply that farmers' agricultural production can be

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influenced by enhancing farmers' access to these inputs at the time of need through support instruments such as the use of subsidies.

Factor 4: Economic/Technological (constraints to accessing planting materials)

The fourth factor, which accounts for 8.58% of the total variance and has an Eigen value of 1.20, focuses on constraints related to accessibility of planting materials. This factor has variables with strong factor loadings as shown, with high cost of planting materials (0.83) and the unavailability of planting materials (0.79). This result is consistent with past studies that have reported that for smallholder farmers to increase agricultural output and enhance food security, they must have access to high-quality planting materials [38]. However, because of their high costs, scarcity, or lack of knowledge, smallholder farmers frequently encounter difficulties gaining access to these resources. This result underscores the need to resolve these barriers with focused interventions.

Factor 5: Technology (challenge of pest issues)

The fifth factor, with a high positive factor loading (0.89), accounts for 7.50 % of the total variance and has an Eigen value of 1.05, focusing on the constraint of pest issues. Agriculture is associated with pest risk [39]. The result indicates the importance of pest management in agricultural production.

Factor 6: Socio-financial (constraints of land ownership)

The sixth factor, which accounts for 7.30 % of the total variance and has an Eigen value of 1.02, focuses on constraints related to land tenure, which has a high factor loading of 0.91. Food security in Africa is affected negatively by malfunctioning land tenures [40]. Therefore, a secure land tenure is needed, particularly among smallholder farmers, to increase their productivity.

Furthermore, to examine the association between the identified factors and farmers' food security, a cross-tabulation was done using the variables that were most highly correlated with the principal component/factor. The association between farmers' production challenges and food security was examined using the chi-square testing of cross tabulations of the variable and the results presented in Table 4. The study reveals that the variables: high cost of planting material, fertiliser access, membership of farming organisation, pest issues, and land tenure are significant potential influencers of food security. It could be inferred from the Chi-square test that there are significant differences between food secure and food-insecure farmers with regard to the identified major challenges in agricultural production.

A higher proportion of farmers who acknowledged being challenged by the high cost of planting material were food insecure (73.1 %). A higher share of farmers with

difficulty in accessing the use of fertilisers was food insecure farmers at 67.9 %. Interventions aimed at enhancing access to agricultural technology such as improved seeds which leads to higher productivity, has the potential to reduce farming households' food insecurity [41]. Inarguably, varying socio-economic status and livelihood resource endowments among households affect their livelihood outcomes among which is improved food security, implying that high value of farm outputs has a likelihood of reducing farmers' food insecurity [42]. Furthermore, farmers grouped as food insecure were mostly challenged with pest issues (73.6 %). Losing crops due to external factors like diseases and pests, highly undermined a farming households' food security [43].

In addition, the result of the multiple regression in Table 5 shows that as a farmer aged, there was a decrease in their food security index implying that they were to be food secure. Farmers experiencing difficulty in accessing markets have higher food security index value than those not experiencing such challenge and consequently are less food secured. The result underscores the importance of farmers having access to markets to purchase inputs and make good returns from the produce sales. According to Torero [44], when market information and markets themselves are not accessible to smallholder farmers, they capture little of the value that they create. Likewise, accessibility to markets and adequate market information are vital to agricultural value chain growth [45]. Furthermore, farmers experiencing pest issues have higher FSI than others. Loss of food to pest leads to reduction in its availability and loss of income for other purchases. The study reveals significant locational differences in FSI among the farmers. All the States had higher FSI than the reference State (Akwa Ibom), indicating that the level of food security was better off in Akwa Ibom.

Results of focus group discussions

To have a better understanding of the challenges facing smallholder farmers in their production and what could be done, the farmers were asked "What are the challenges faced in cassava and yam production, and what can be done to address the challenges?" Four focus group discussions (FGD) were organised in four states with the exclusion of Edo and Cross River States due to budget constraints; each FGD had about 25 to 30 participants. Each FGD session lasted for about three hours. After seeking the farmers' consent for participation in the group discussions, the principal investigator briefed the farmers on the research topic, demonstrating some improved technologies for the chosen crops and then dividing the participants into four sub-groups to discuss the challenges and come up with solutions for them.

The data was pooled together for descriptive analysis to get more in-depth information on the challenges they face in cassava and yam production, and to establish the

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strategies adopted in dealing with the challenges. Specifically, frequency and percentage analysis of the number of times a particular challenge, given a list of challenges identified from the literature, was rated by the farmers. Also, a thematic analysis of the co-produced farmers' preferred solutions was done by identifying key themes in responses and summarising like-statements as made by the farmers.

What are the challenges faced in cassava and yam production?

Results reveal the following: as can be seen in Figure 2, the most identified constraints to cassava and yam production were lack of/inadequate infrastructural facilities and financial issues. The FGD activity while increasing public awareness of production challenges, effects and need for interventions, it reinforces the results of analysis or findings from the larger field survey. The result underscores the importance of providing adequate infrastructure like market structures to enhance availability and accessibility to production inputs and food along food value chains as well as providing finance/credit support to smallholder farmers among other needs. Studies have shown that when households have access to credit, they engage in various income-generating activities that help improve their food security. Also, farmers with better purchasing power for agricultural inputs are able to improve their productivity and output and in turn their food security [33,43].

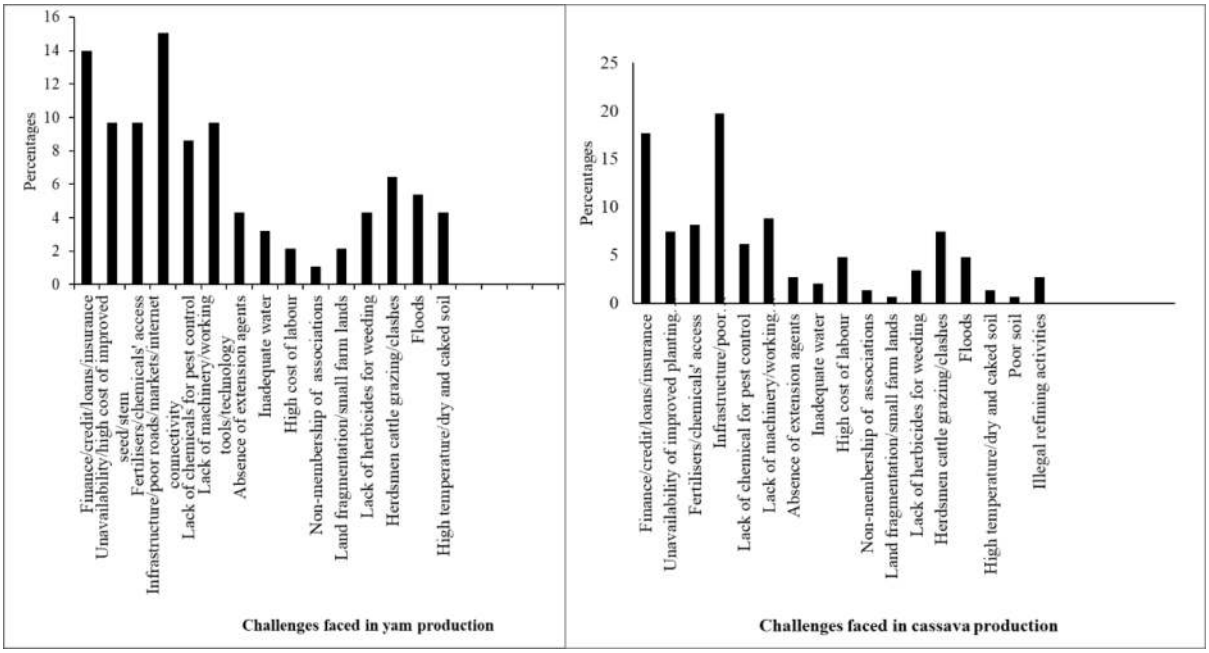

Figure 2: Challenges of agricultural production

Source: Author's computation

What can be done to address the challenges faced in your crop production?

The farmers after sharing their experiences during the mini group discussions held across four States were asked to suggest solutions to dealing with identified

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challenges and in no order of priority, the following summarised actions were suggested for improving agricultural production:

- Farmers want herdsmen banned from having their cattle graze on cultivated farmlands.
- Government and relevant organisations should provide enhanced access to improved seeds/stems.
- Provision of adequate infrastructure including repairs of dilapidated roads, markets and health centres.
- Government should support farmers in provision of chemicals/pesticides for weed and pest management.
- Farmers want to be educated/enlightened by researchers and extension service providers on improved technology including waste utilisation for enhanced crop growth.
- Relevant agencies should improve control of flooding incidences arising from opening of dams.
- Government should act on stopping illegal oil refining activities in the study area.
- Farmers should ensure they harvest their crops before floods occur.
- Farmers could leverage on indigenous techniques for disease and pest management such as spraying ashes on crops and setting traps.
- The formation of farmers' associations or cooperatives to aggregate produce would enhance access to farm inputs and credit facilities.

CONCLUSION AND RECOMMENDATIONS FOR DEVELOPMENT

Many people in Nigeria depend on agriculture as their source of livelihood and by which they ensure their food security. The results of the study illustrated how socioeconomic, financial, and technological factors may affect smallholder farmers' food security in south-south geopolitical zone of Nigeria. A sizeable proportion of farmers face food insecurity, and there are differences in the experiences of food insecurity among the farmers that could be attributed to location, education attainment, age-related vulnerabilities, access to agricultural production inputs and related factors. Food insecurity among farmers can be made worse by challenges that impede market participation, agricultural productivity and access to funds and other farm inputs. Consequently, there is need to take into cognisance farmers' unique conditions in addressing the identified challenges limiting agricultural production in order to enhance farmers' food security. Given that smallholder farmers are essential to maintaining food security in households and communities, this study has significant implications for tackling food insecurity in the area. There is need to develop all-encompassing plans that incorporate production inputs and market access, enhance social capital development and improved funding for

agriculture, all of which could enhance the general resilience and well-being of southern Nigerian rural communities and particularly addressing food security challenges among smallholder farmers. The study provides empirical evidence of the association of the challenges smallholder farmers face in production with their food security status and also, as a base for future research to investigate the causes of the differences in food security across States and the effects of differing or peculiar production and environmental challenges.

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Conflict of Interest

The authors declare no conflict of interest.

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Table 1: Food Insecurity Experience Scale Construct

Items		Yes	No
Q1	You were worried you would not have enough food to eat		
Q2	You were unable to eat healthy and nutritious food		
Q3	You ate only a few kinds of foods		
Q4	You had to skip a meal		
Q5	You ate less than you thought you should		
Q6	Your household ran out of food		
Q7	You were hungry but did not eat		
Q8	You went without eating for a whole day		

Source : FAO [22]

Table 2: Prevalence of food insecurity experience across selected demographics

Variable	Total	Food insecure	Food secured
Location			
Akwa Ibom	467	245 (52.47)	222 (47.54)
Bayelsa	146	128 (87.67)	18 (12.33)
Cross Rivers	434	328 (75.58)	106 (24.42)
Delta	481	336 (69.85)	145 (30.15)
Edo	324	250 (77.16)	74 (22.84)
Rivers	516	416 (80.62)	100 (19.38)
Pearson Chi-square	133.11 (0.00)*		
Gender			
Male	1342	740 (72.20)	285 (27.80)
Female	1025	963 (71.76)	379 (28.24)
Pearson Chi-square	0.06 (0.82)		
Age			
≤ 36	229	169 (73.80)	60 (26.20)
37 – 53	1003	758 (75.57)	245 (24.43)
54 – 70	1075	727 (67.63)	348 (32.37)

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≥ 71	58	46 (79.31)	12 (20.69)
Pearson Chi-square	18.39 (0.00)*		
Education			
No formal education	362	290 (80.11)	72 (19.89)
Primary	641	444 (69.27)	197 (30.73)
Secondary	864	586 (67.82	278 (32.18)
Tertiary	501	383 (76.45)	118 (23.55)
Pearson Chi-square	26.52 (0.00)*		
Land tenure			
No	629	452 (71.86)	177 (28.14)
Yes	1739	1251 (71.94)	488 (28.06)
Pearson Chi-square	0.01 (0.97)		
Off-farm income			
No	953	708 (74.29)	245 (25.71)
Yes	1411	992 (70.30)	419 (29.70)
Pearson Chi-square	4.48 (0.03)*		

Source: Field Survey, 2023. Values in parenthesis are percentages. *Significant at 5% level

Table 3: Principal Component matrix of challenges affecting farmers' agricultural production

Items	Factors					
	1	2	3	4	5	6
Difficulty in market access	0.79					
Inability to access improved varieties	0.67					
Lack of adequate loan	0.75					
Membership of farmers' association		0.81				
Participation in extension services program/workshop		0.75				
Credit access		0.73				
Erosion issues			0.60			

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Access and application of chemicals			0.82			
Access and application of fertilisers			0.82			
High cost of planting material				0.83		
Unavailability of planting material				0.79		
Pest issues					0.89	
Land ownership						0.91
Eigen values (Total)	2.48	2.27	1.26	1.20	1.05	1.02
% of Variance	17.7	16.2	9.00	8.58	7.50	7.30
Cumulative %	17.7	33.9	42.9	51.5	59.0	66.3
Kaiser-Meyer-Olkin Measure of Sampling Adequacy.	0.66					
Bartlett's Test of Sphericity	Approx Chi^2	5364.7 (0.00)				

Extraction Method: Principal Component Analysis. Rotation Method: Varimax with Kaiser Normalization. Values in bold are significant

Table 4: Association between farmers' production challenges and food security

Description	Food secured	Food insecure	Total	Chi^2 test
High cost of planting materials	488 (26.93)	1324 (73.07)	1812	0.02*
Difficulty in market access	463 (26.50)	1284 (73.50)	1747	0.00
Accessibility and application of fertilisers	329 (32.13)	695 (67.87)	1024	0.00**
Membership of farmers' association	271 (33.58)	536 (66.42)	807	0.00**
Pest issues	432 (26.44)	1202 (73.56)	1634	0.01**
Land ownership	487 (28.04)	1250 (71.96)	1737	0.93

Source: Authors' computation. ** and * significance difference at 1% and 5%, respectively. Values in parenthesis are percentages of total

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Table 5: Regression estimates of the relationship between food security status and socioeconomic factors

Variables	Coefficients	Std. Err.	P >|t|
Intercept	-0.442	0.151	0.003**
Gender	0.023	0.041	0.576
Education years	-0.004	0.004	0.276
Age	-0.005	0.003	0.068*
Farming years of experience	0.001	0.002	0.585
Difficulty in market access	0.142	0.050	0.004**
Membership of farmers' association	0.017	0.050	0.730
High cost of planting materials	0.080	0.050	0.109
Inability to access and apply fertilisers	0.008	0.047	0.868
Pest issues	0.133	0.045	0.003**
Location			
Bayelsa	0.829	0.103	0.000**
Cross Rivers	0.473	0.076	0.000**
Delta	0.354	0.076	0.000**
Edo	0.554	0.075	0.000**
Rivers	0.590	0.075	0.000***

Source: Authors' computation. ** and * significance difference at 1% and 10%, respectively

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Appendix

Table A1: Sample size computation

State	Population	Sample size	Probability proportion of total population	Proportionate sample size
Akwa Ibom	572002	400	0.195	468
Bayelsa	178537	399	0.061	146
Cross River	532005	400	0.181	434
Delta	588842	400	0.200	481
Edo	434051	400	0.148	354
Rivers	632648	400	0.215	516
Total	2938085	2399	1.000	2399

Source: National Bureau of Statistics/Federal Ministry of Agriculture and Rural Development [23]

Table A2: Distribution of respondents across surveyed communities

S/N	State	Communities	Frequency	% Share of community total	% Share of sample size
1	Akwa Ibom	Ikot Ebak	73	15.63	3.08
2		Abia Okpo	56	11.99	2.36
3		Ikot Abia Idem	50	10.71	2.11
4		Ikot Ekpene	79	16.92	3.34
5		Urue-Ita	48	10.28	2.03
6		Uru-Iting	42	8.99	1.77
7		Udung-Ukpor	65	13.92	2.74
8		Udung Uwe	54	11.56	2.28
9	Bayelsa	Amassoma	69	47.26	2.91
10		Kiama	17	11.64	0.72
11		Zarama	6	4.11	0.25
12		Bolou-Orua	5	3.42	0.21
13		Angiama	15	10.27	0.63
14		Odi	22	15.07	0.93
15		Gbarain	6	4.11	0.25

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16		Toru Orua	6	4.11	0.25
17	Cross River	Igbo Emabana	52	11.98	2.20
18		Ishibori	50	11.52	2.11
19		Obubra station	76	17.51	3.21
20		Ogboja	83	19.12	3.51
21		Okuku	34	7.83	1.44
22		Ugaga	40	9.22	1.69
23		Usumutong	61	14.06	2.58
24		Uwakande	38	7.90	1.60
25	Delta	Isumpe	46	9.56	1.94
26		Ndemili	59	12.27	2.49
27		Ogwashi Ukwu	36	7.48	1.52
28		Ugbolu	72	14.97	3.04
29		Abraka	98	20.37	4.14
30		Ekerejeta	63	13.10	2.66
31		Sapele	54	11.23	2.28
32		Amukpe	53	11.02	2.24
33	Edo	Abudu	35	9.92	1.48
34		Amahor	42	11.90	1.77
35		Ebelle	50	14.16	2.11
36		Igbanke	50	14.16	2.11
37		Ilushi	59	16.71	2.49
38		Osasinwin Oba	55	15.58	2.32
39		Ubiaja	33	9.35	1.39
40	Rivers	Borobara	44	8.53	1.86
41		Kporghor	50	9.69	2.11
42		Bdere	82	15.89	3.46
43		Kpor	79	15.31	3.34
44		Abara Etche	62	12.02	2.62
45		Umuechin	76	14.73	3.21

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46		Isiokpo	79	15.31	3.34
47		Igwuruta	44	8.53	1.86
	Total		2368		100.00

Table A3: Correlation matrix of FIES statements

	Worried about food	Unable to eat healthy	Ate only few kinds	Skip meal	Ate less food	Household out of food	Hungry but no food	Without food for a day
Worried about food	1							
Unable to eat healthy	0.7423	1						
Ate only few kinds	0.5436	0.6205	1					
Skip meal	0.4899	0.5723	0.6224	1				
Ate less food	0.412	0.43	0.4749	0.6025	1			
Household out of food	0.4074	0.4453	0.4555	0.5105	0.6543	1		
Hungry but no food	0.2154	0.2522	0.2339	0.2816	0.3672	0.4378	1	
Without food for a day	0.2318	0.2757	0.2312	0.2435	0.2933	0.3584	0.7261	1

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