

AGRICULTURAL COMMERCIALIZATION AND SMALLHOLDER FARMERS' FOOD SECURITY IN NIGERIA

Oluwaseun Gabriel Ajisafe¹, Chuks Onyeka Idiaye², Isaac Busayo Oluwatayo³

Abstract

The study examined the impact of agricultural commercialization on the food security status of smallholder farmers in Nigeria, a nation where agriculture has a crucial role in both economic sustainability and food provision. Utilizing the most recent data from the Nigeria General Household Surveys (NGHS 2018/19) and employing an Instrumental Variable Probit regression model, the research assesses the relationship between the level of commercialization, as measured by the Household Commercialization Index (HCI), and food security outcomes among smallholder farmers. The outputs reveal a significant positive link between higher levels of commercialization and improved food security. Specifically, an increase in the HCI correlates with a notable rise in the probability of achieving food security, with a statistically significant average marginal effect (AME) of 0.061, highlighting the potential benefits of market-oriented farming practices. This study also considers various socio-economic factors, including household size, marital status, and access to credit, to understand their influence on food security. The obtained results underscore the significance of supporting agricultural commercialization as a strategy to enhance food security among smallholder farmers in Nigeria. Paper calls for targeted policy interventions to facilitate access to markets, improve agricultural education, and provide financial services to farmers, aiming to bolster commercial activities and, consequently, food security.

Key words: Agricultural commercialization, food security, smallholder farmers, Nigeria, IV Probit.

JEL⁴: Q20, Q100, Q13

- 1 Oluwaseun Gabriel Ajisafe, M.Sc., Department of Economics and Finance, Middle Tennessee State University, Murfreesboro, USA, Phone: +1629 261 12 58, E-mail: oluwaseungbrl@gmail.com, ORCID: <https://orcid.org/0009-0005-1396-4575>
- 2 Chuks Onyeka Idiaye, Ph.D., Department of Agricultural Economics, University of Ibadan, Ibadan, Nigeria, Phone: +234 703 136 28 68, E-mail: chuksidiaye@gmail.com, ORCID: <https://orcid.org/0000-0001-7204-7586>
- 3 Isaac Busayo Oluwatayo, Ph.D., Department of Agricultural Economics and Agribusiness, University of Venda, Thohoyandou, South Africa, Phone: +27 784 493 162, E-mail: isaac.oluwatayo@univen.ac.za, ORCID: <https://orcid.org/0000-0002-8649-2557> (corresponding author)
- 4 Article info: Original Article, Received: 25th February 2025, Accepted: 23rd April 2025.

Introduction

In Africa, a substantial portion of the population relies on agriculture for sustenance (Goldman, 1995; IFAD, 2011). It provides food, clothing, shelter, and employment for over 75% of the people (Mgbakor et al., 2014). Enhancing the agricultural sector's productivity, profitability, and sustainability is not just a pathway but a necessity to urgently mitigate food insecurity across the continent (Asenso Okyere, Jemaneh, 2012; Dawson et al., 2016). Nigeria, with its burgeoning population, places significant reliance on its agricultural workforce to meet the escalating food demands (Bello et al., 2024). However, the fundamental axiom prevails: to feed a nation, one must first feed oneself and one's family. The effectiveness of subsistence farming and its diverse impacts on Nigeria's economy, food security, and poverty reduction depend on several factors. These include soil fertility, access to land and water, fertilizer availability, adoption of improved seeds, affordability of farm inputs, access to credit, involvement of pest and disease management, implementation of new farming technological solutions and practices, and, crucially, the level of commercialization within the agricultural sector (Adepoju et al., 2022; Prince et al., 2023).

Smallholder farming, a unique and resilient practice, remains a dominant feature of Nigeria's agricultural landscape, particularly in rural areas where a significant part of the population relies on agri-food production for their livelihood (Igwe et al., 2020). Characterized by the cultivation of small plots of land and the production of various crops, smallholder farmers grow food for personal consumption and engage in commercial activities to sustain their livelihoods. Beside the integral role of agriculture in Nigeria's socio-economic fabric, food security remains a pressing concern, with a considerable share of the population enduring hunger and malnutrition (Oyinloye et al., 2018; Akinyetun, 2018). Wudil et al. (2022) highlight the worsening food security trends in sub-Saharan Africa in recent years, noting that food insecurity in the region has been rising steadily since 2015. Understanding the dynamics of commercialization within smallholder farming and its impact on farmers' food security is crucial in formulating effective strategies to address the nation's food challenges.

The nexus between agricultural commercialization and food security in Nigeria has been an area of considerable academic focus, with studies identifying several key factors that influence both. Several authors (Agwu et al., 2013; Olanrewaju et al., 2016; Ogundele, 2020; Oparinde et al., 2020; Otekunrin et al., 2021) have highlighted the critical role of educational level, size of farms, and availability of extension services in enhancing commercialization and, subsequently,

food security at national or regional level in Nigeria. Expanding beyond Nigeria, Ochieng et al. (2020) in Kenya demonstrated that commercialization positively affects dietary quality and food security by increasing nutrient intake and household income. Collectively, these studies contribute to a nuanced understanding of how commercialization influences food security, although this study stands out by utilizing unique national-level data to delve into these dynamics within the Nigerian context specifically. This research, therefore, adds to the existing literature by examining the interplay of commercialization and food security through a localized lens, providing targeted insights for policy and practice in Nigeria's agricultural sector.

Materials and Methods

Data description

The General Household Survey-Panel (GHS-Panel) was launched together with the World Bank Living Standards Measurement Study (LSMS) team. It was a part of the Integrated Surveys on Agriculture (ISA) program. Wave 4 of the Nigeria General Household Surveys (NGHS 2018/19) comprises two seasonal visits, gathering post-planting and post-harvest data designed to be representative at the zonal level, covering 5,000 households, each potentially including multiple farmers. It encompasses six zones along with rural and urban areas within these zones, as outlined by the Nigerian National Bureau of Statistics (NBS, 2019). At the time this study was done, mentioned was the most recently available wave of the GHS data. Relevant to this study are details regarding weekly food consumption, estimated crop values, sales proceeds, and socio-economic characteristics, including household size, income, age, sex, marital status, and education level. Smallholders are defined in this study as farmers with less than two hectares of farmland, including individuals within households who possess their farmland and are considered as respondents. The final sample used in this study, comprising 7,343 farmers, consisted of individuals with complete information. This same dataset was also utilized by Mgonezulu et al. (2024).

Methods of data analysis

The Household Commercialization Index (HCI) was computed as the ratio of the „total value of crop sales in the market” to the “estimated value of crop harvested”. Both variables are readily available in the NGHS data set.

$$HCI = \frac{\text{Total Value of Crop Sales in the Market}}{\text{Total Value of Crop Harvested}}$$

The HCI ranges between 0 and 1, while measuring the farmers' level of commercialization. Farms with the HCI between 0.01 and 0.25 belong to the group of farms with low-level commercialization. Farms with HCI between 0.251 and 0.50 belong to middle-level commercialization farms, or farms with HCI above 0.50 are grouped to high-level commercialization farms (Olanrewaju et al., 2016).

According to the Food and Agriculture Organization of the United Nations (FAO), an individual is classified as experiencing hunger when its calorie intake falls below the minimum dietary energy requirement (MDER), a threshold set by the organization (Michels et al., 2024). By comparing the distribution of calorie intake with the MDER, it becomes straightforward to determine whether the individual is suffering from hunger. In line to the Living Standard Measurement Study (LSMS) survey manual, all datasets turned to weekly consumed quantities of food were unified per kilogram according to conversion factors of local to standardized units.

The overall content of calories for any food product was gained after multiplying the food quantity with its calorie conversion factor. This figure was divided by seven to arrive at calories consumed per day. For any household within the sample the HFSI has been calculated as a ratio between the daily calorie intake and requirement of household. Household could be assumed food-insecure if the value for its HFSI is below one, implying its incapableness to meet required calories at daily basis. If the value for HFSI is equal or above one it means that household could be assumed as food secure, i.e. it could fit or exceed the energy requirement at daily basis (Fadare et al., 2019; Adekunle et al., 2020). Calorie adequacy is among the most used food security indicators in empirical studies (Manikas et al., 2023).

$$\text{HFSI} = \frac{\text{HDCI}}{\text{HDCR}}$$

Where (FAO, 2018),

HFSI = Household food security index

HDCI = Household daily calorie intake (kcal/day)

HDCR = Household daily calorie requirement (kcal/day)

HDCR for Nigeria equals to 2,572 kcal per day.

Endogeneity in the context of commercialization refers to situations where commercialization is correlated with unobserved factors that also influence the outcome variable, such as food security/insecurity. There are several reasons why endogeneity might occur in the relationship between commercialization and food security status:

- i. *Unobserved Factors*: Certain characteristics or attributes of farmers not captured in the dataset, like innate abilities, entrepreneurial skills, or motivation, may affect both their level of commercialization and their nutritional status. For instance, farmers with higher innate abilities may be more successful at selling their products and managing their nutrition.
- ii. *Reverse Causality*: Relationship between commercialization and food consumption may not be unidirectional. It is plausible that better nutrition enhances productivity, leading to higher levels of commercialization. Conversely, increased commercialization may give farmers more resources to invest in their consumption. This bidirectional causality can lead to endogeneity because the reverse effect confounds the effect of commercialization on nutrition.
- iii. *Measurement Error*: Even with diligent data collection efforts, there may still be errors in measuring variables such as commercialization or nutritional status. These measurement errors can lead to spurious correlations and bias in the Ordinary Least Squares (OLS) estimates.

Because of endogeneity, the OLS estimates of the coefficient representing the effect of commercialization on nutritional outcomes will be biased. This bias occurs because OLS cannot disentangle the effects of commercialization from those of the correlated unobserved factors. As a result, the estimated relationship between commercialization and food security status may not accurately reflect the actual causal effect. To rectify this problem and attain unbiased estimates, researchers often turn to instrumental variable (IV) regression methods, which correct for endogeneity by leveraging valid instruments to isolate the exogenous variation in the independent variable under scrutiny. This could also be achieved through approaches like Two-Stage Least Squares (2SLS) when homoscedasticity is present or the Generalized Method of Moments (GMM) in the case of heteroscedasticity.

In this study, the average cost of transportation in Enumeration Area (EA) is considered as instrument for commercialization. Firstly, transportation costs directly impact farmers' ability to access markets and sell their produce. Lower transportation costs typically enable easier and more frequent market access, facilitating increased commercialization. Conversely, higher transportation costs can hinder market access and reduce commercialization opportunities. Secondly, the EA average cost of transportation is likely to be exogenous to individual food consumption outcomes. That is, they are unlikely to be directly influenced by food security status. Instead, transportation costs are more closely tied to distance to markets, road infrastructure, and fuel prices, which are independent of an individual's food security status. Thirdly, transportation costs are plausibly correlated with commercialization but not directly

with food security status, satisfying the conditions for a valid instrument. Therefore, the EA average cost of transportation meets the criteria of being firmly correlated to commercialization, while being uncorrelated with omitted variables affecting food security status, except indirectly through commercialization. Thus, it serves as a valid instrument in addressing endogeneity in this study. The decision to use this instrument was influenced by the work of Ochieng et al. (2020), who used the average number of motorcycles used by farms settled in certain ward (county) and leading market sellers at county level as the commercialization instruments. This study's choice of instrument relates to their first instrument.

Analysis of the effect of agricultural commercialization on food security

An instrumental variable probit regression model (2SLS) was used to analyze the effect of agricultural commercialization on food security. This regression analysis studies the association between a categorical dependent variable and at least one endogenous independent variable among a set of explanatory variables. The name probit regression is used when the dependent variable has only two values, 0 and 1, or Yes or No (binary). The model used for this study is given as:

$$X_1 = \beta_1 Z + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 \dots + \beta_n X_n + \mu$$

$$Y = \alpha_0 + \alpha_{11} + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 X_4 + \dots + \alpha_n X_n + \varepsilon$$

Where,

Y = Household food security status (1 = food secure, 0 = food insecure)

X_1 = Household crop commercialization index

Z = EA average market transportation costs

X_2 = Sex of household head (1 = male; 0 = otherwise)

X_3 = Age of household head (years)

X_4 = Marital status (1 = married; 0 = otherwise)

X_5 = Household size

X_6 = Land ownership (1 = owned; 0 = otherwise)

X_7 = Access to extension visits (1 = access; 0 = otherwise)

X_8 = Membership of group (1 = belong to group; 0 = otherwise)

X_9 = Access to credit (1 = access; 0 = otherwise)

X_{10} = Income from non-farm activities

X_{11} = North Central (1 = belong to zone; 0 = otherwise)

X_{12} = North-East (1 = belong to zone; 0 = otherwise)

X_{13} = North-West (1 = belong to zone; 0 = otherwise)

X_{14} = South-East (1 = belong to zone; 0 = otherwise)

X_{15} = South-South (1 = belong to zone; 0 = otherwise)

β and α = coefficients associated with explanatory variables

μ and ε = error terms representing unobserved factors

Results and Discussion

Socio-economic characteristics of smallholder farmers in Nigeria

Table 1. outlines the socio-economic characteristics of smallholder farmers in Nigeria, highlighting significant gender disparities with 79% male and 21% female farmers. This gender ratio reflects the traditional male dominance in Nigerian agriculture, a finding supported by Olanrewaju (2016), who noted a similar trend with 91% male and about 9.4% female household heads in agricultural settings.

The average age of the household heads is 51 years, indicating that most smallholder farmers are in their productive years and capable to active farming. Educationally, a majority of these farmers (34.73%) have completed primary education, suggesting a basic level of literacy that impacts their farming practices. Marriage is prevalent among farmers, with about 70% married, a cultural reflection of the community's values, as also observed by Hussayn et al. (2020), who reported that 72.78% of farmers were married.

Household size varies, with a significant portion (55.86%) having between 1 and 5 members, and average size of 6 persons. This larger household size is beneficial as it provides labor for farming, which is essential in regions where family is a primary labor source. Most of these households operate on a small scale, with 76% managing less than one hectare, indicative of the fragmented land holdings typical in Nigerian smallholder farming.

Financially, the farmers face substantial challenges, as 87% have no savings in banks, 83% have not applied for loans, while vast majority (97%) have not accessed agricultural extension services within the last year. These figures underscore the critical gaps in financial inclusion and support services, which are essential for enhancing agricultural productivity and sustainability in the region.

Table 1. Distribution of smallholder farmers by their socio-economic characteristics

Variables	Frequency	Percentage
Sex		
Female	1,543	21.01
Male	5,800	78.99
Age		
18 – 20	60	0.82
21 - 30	757	10.31
31 - 40	1,419	19.32
41 – 50	1, 561	21.26
51 – 60	1,557	21.20
>60	1,989	27.09
Educational level		
No formal	2,484	33.83
Primary	2,550	34.73
Secondary	1,876	25.55
Tertiary	433	5.90
Marital status		
Unmarried	2,197	29.92
Married	5,146	70.08
Household size (persons)		
1 - 5	4,102	55.86
6 - 10	2,564	34.92
>10	677	9.22
Farm size (in ha)		
<1	5,601	76.28
1 – 2	1,742	23.72
Savings through banks cooperative/commercial		
Yes	924	12.58
No	6,419	87.42
Advice from extension		
Yes	251	3.42
No	7,092	96.58

Source: Authors' computation, 2024.

Agricultural commercialization among smallholder farmers in Nigeria

Table 2. assesses the commercialization levels of smallholder farmers in Nigeria using the commercialization index developed by Strasberg et al. (1999). This index categorizes commercialization into three levels, as low (0.01-0.25), medium

(0.251-0.5), and high (above 0.5). The findings reveal that a significant majority of farmers, 81.67%, fall into the low commercialization category, while 10.21% achieve a medium level, and only 8.12% reach high commercialization levels, with an average index across households of 0.17.

These statistics indicate a predominant trend of subsistence farming with limited market engagement among smallholder farmers. Such low levels of commercialization suggest that most farmers focus on producing enough to meet their own family's needs rather than selling their produce. Consequently, this limited market participation contributes to a higher likelihood of food insecurity among these farmers, as enhanced commercialization typically provides more stable income streams that can reduce poverty and mitigate food insecurity risks. This aligns with some previous research (Agwu et al., 2013; Mgbenka et al., 2016; Benson et al., 2020), who also noted a generally low orientation towards crop commercialization in similar regions. Top of Form

Table 2. Distribution of smallholder farmers according to level of commercialization

Commercialization index	Frequency	Percentage (%)
Low (≤ 0.25)	5,997	81.67
Medium (0.251-0.50)	750	10.21
High (0.51 – 1.00)	596	8.12
Total	7,343	100.00
Standard deviation	0.23	
Mean comm. Index	0.17	
Min. comm. index	0.00	
Max. comm. Index	1.00	

Source: Authors' computation, 2024.

Food security status of smallholder farmers in Nigeria

An evaluation of the food security status among smallholder farmers in Nigeria, based on the recommended daily calorie intake of 2,507 kcal, reveals significant challenges (Table 3.). Approximately 87% of the 7,343 farmers surveyed were classified as food insecure, with only 956 farmers meeting their daily nutritional requirements, around 13% of respondents. This high level of food insecurity is largely attributed to the inefficiency of small-scale agricultural production, which predominantly sustains only the immediate family needs of farmers.

Table 3. Summary statistics and food security status for smallholder farmers

Food security status	Food insecure	Food secure	Total
Number of farmers	6,387	956	7,343
Share	86.98	13.02	100.00

Source: Authors' computation, 2024.

This finding is consistent with research by Matemilola and Elegbede (2017), who noted that about 90% of agricultural output from Nigerian smallholders is insufficiently beyond subsistence. Further supporting this, Obasan et al. (2017) reported that 59.6% of rural households were food insecure. Similarly, Ahmed and Abah (2014) found a 61% food insecurity rate among surveyed households, with only 39% achieving food security. These results highlight a significant prevalence of food insecurity, which contrasts with Ojeleye et al. (2014), who reported a higher rate of food security (66%) among their respondents, indicating variability in food security status across different studies and regions.

Effects of agricultural commercialization on food security of smallholder farmers

To evaluate the impact of agricultural commercialization on food security among smallholder farmers in Nigeria, an instrumental variable Probit regression model was utilized. The results, underscored by a Wald test of exogeneity with a p-value of 0.000, indicate significant exogenous relationships in the model, suggesting robustness in the variable selection. Analysis detailed in Table 4. shows only significant determinants of food security among the farmers in this study.

Table 4. Estimates of IV Probit regression model for effect of agricultural commercialization on food security

Variable	AMEs	SE	Z	P> Z
HCI	0.061	0.020	3.03	0.002***
Married	-0.573	0.164	-3.50	0.000***
Household size	-0.013	0.003	-3.69	0.000***
Access to credit	0.155	0.079	1.95	0.051*
Savings	-0.410	0.171	-2.40	0.016**
Higher education	0.370	0.135	2.74	0.006***
Extension services	0.691	0.206	3.35	0.001***
<i>Log-likelihood</i>	-16356.43			
<i>Wald chi²</i>	378.68			
<i>Prob>chi²</i>	0.0000			

Source: Authors' computation, 2024.

*** (p<0.01), ** (p<0.05), * (p<0.10)

The Household Commercialization Index (HCI) emerges as a particularly influential factor. The analysis, with a statistically significant average marginal effect (AME) of 0.061 at the 1% level, reveals that for each unit increase in HCI, there is a corresponding 6.1% increase in the likelihood of a farmer achieving food security. This substantial relationship underscores the pivotal role that commercialization plays in bolstering food security, presumably through the increased income that comes from market sales of agricultural produce. This result is consistent with Olanrewaju (2016) and Manja et al. (2025), whose findings revealed that the area of agri-food production commercialization could be seen as income-determining factor that will affect food security.

Marital status presents an interesting dynamic. Being married is linked with a dramatic 867.3% reduction in the probability of being food secure, an effect size that is statistically significant at the 1% level with an AME of -0.573. This suggests that the increased responsibilities and larger household sizes associated with marriage may substantially detract from food security for these farmers.

Household size is statistically significant at 1% with a negative relationship with the food security status of smallholder farmers. The inverse relationship between household size and food security status indicates that a rise in household size will bring about a 0.013 decrease in the chance of smallholder farmers being food secure. This corroborates with the study of Oparinde et al. (2020) who explained that a rise in household size would cause the household to have problems meeting basic household needs such as good nutrition.

Considering access to credit, with an AME of 0.155 and a p-value slightly above the conventional threshold at 0.051, suggests a positive but less significant influence on the likelihood of food security among smallholder farmers. This value indicates that there could be a 15.5% increase in the probability of a farmer being food secure with access to credit. The closeness of the p-value to the standard cutoff hints at a potentially important trend worth exploring further, as access to credit is often critical for enabling farmers to invest in productivity-enhancing inputs and technologies, which could, in turn, lead to improved food security outcomes.

The presence of savings in cooperative or commercial banks is significantly associated with food security among smallholder farmers in Nigeria, showing an AME of -0.410 at a 5% significance level (p-value of 0.016). This counterintuitive negative impact suggests that farmers with savings are 41% less likely to be food secure. This could imply that such savings are perhaps earmarked for future investments or emergencies rather than current food expenditures. Alternatively, this pattern may reflect that even those who are able to save face other substantial challenges that

savings alone cannot offset, such as variability in agricultural productivity or market access issues. Mentioned relationship presents a complex aspect of the financial behavior of smallholder farmers, meriting deeper analysis to unravel the intricacies between financial management and food security outcomes.

The influence of education is decidedly positive. Producers with better education have a 37% higher chance to reach food security, indicated by an AME of 0.370, significant at the 1% level. Mentioned likely reflects the benefits of educational attainment in improving agricultural productivity and access to market information, which in turn enhances food security. This is in line with Naz et al. (2023), who identify education as one of the positive determinants of food security among rural households in developing countries, or with studies of Abu, Soom (2016), Okon et al. (2017) or Aboaba et al., (2020), that observed the same indicator for Nigeria.

Lastly, the availability of extension services is crucial. An AME of 0.691, significant at the 1% level, suggests that access to these services is associated with a 69.1% increase in the likelihood of achieving food security. This highlights the critical role of support services in enhancing farmers' capabilities and, consequently, their food security status.

Conclusion and Recommendations

The study revealed pronounced gender imbalances in Nigeria's smallholder sector, with almost four-fifths of farmers being male. Household heads were on average middle-aged (around 51 years), predominantly married, and largely educated only to the primary level. Farm sizes were small (over 75% cultivating area is less than one hectare), and most households had limited access to formal savings, credit, or extension services. Commercialization levels were low, over 80% of farmers operated at subsistence scales, while 87% of households were food insecure under 2,507 kcal benchmark.

The IV Probit analysis had shown that increasing commercialization (HCI), higher education, and access to extension services had significantly boosted food security, whereas larger household sizes and marital responsibilities had detracted from it. Access to credit displayed a positive but marginally significant effect, while holding bank savings was paradoxically associated with lower immediate food security, suggesting those funds were reserved for future investments rather than daily consumption.

In line to outcomes of performed study, there are proposed following recommendations to address the constraints facing smallholder farmers in

Nigeria and improve their food security through enhanced commercialization and support systems:

- ***Strengthen market linkages and commercialization efforts*** - Support should be given to the formation of farmer cooperatives and aggregation models that can improve access to markets and bargaining power. In addition, investments in rural infrastructure, such as feeder roads, storage facilities, and market hubs, would reduce post-harvest losses and facilitate greater market engagement.
- ***Enhance financial inclusion among smallholder farmers*** - Financial products tailored to agricultural cycles should be developed in partnership with banks, microfinance institutions, and fin-techs. Additionally, mobile banking platforms and community savings schemes can be promoted to improve access to savings and credit for rural households.
- ***Expand and modernize agricultural extension services*** - Given their significant role in improving food security, extension services should be scaled up and made more accessible. ICT-based solutions such as SMS alerts, mobile applications, and farmer field schools should be employed to deliver real-time, localized advisory support, especially targeting women and underserved farmers.
- ***Integrate agricultural education and capacity building into community programs*** - Providing functional literacy and vocational training that covers modern agronomy, market orientation, and financial management will empower farmers to adopt improved practices. Short courses and certifications in agribusiness and value chain development should also be encouraged.
- ***Promote enabling policies and institutional support*** - Land tenure reforms should be pursued to facilitate land consolidation and the use of land as collateral. Furthermore, government and private sector collaboration should be encouraged to invest in agricultural research, innovation hubs, and adaptive technologies suited to local contexts.

References

1. Aboaba, K., Fadiji, D., Hussayn, J. (2020). Determinants of food security among rural households in Nigeria: USDA food insecurity experience based measurement (forms) approach. *Journal of Agribusiness and Rural Development*, 56(2):113-124, doi: 10.17306/J.JARD.2020.01295

2. Abu, G., Soom, A. (2016). Analysis of factors affecting food security in rural and urban farming households of Benue State, Nigeria. *International Journal of Food and Agricultural Economics (IJFAEC)*, 4(1):55-68, doi: 10.22004/ag.econ.231375
3. Adekunle, C., Kutu, A., Alori, D. (2020). Effects of Food Price Shocks on Dietary Composition of Farm Households' in Nigeria. *Journal of Agricultural Extension*, 24(3):22-40, doi: 10.4314/jae.v24i3.3
4. Adepoju, O., Esan, O., Akinyomi, O. (2022). Food security in Nigeria: Enhancing workers' productivity in precision agriculture. *Journal of Digital Food, Energy & Water Systems*, 3(2):13-27, https://doi.org/10.36615/digital_food_energy_water_systems.v3i2.2269
5. Agwu, N., Anyanwu, C., Mendie, E. (2013). Socio-Economic Determinants of Commercialization Among Smallholder Farmers in Abia State, Nigeria. *Greener Journal of Agricultural Sciences*, 2(8):392-397, <https://doi.org/10.15580/GJAS.2012.8.110112200>
6. Ahmed, F., Abah, P. (2014). Determinants of Food Security among Low-Income Households in Maiduguri Metropolis of Borno State, Nigeria. *Asian Journal of Social Sciences & Humanities*, 3(1):74-86.
7. Akinyetun, T. (2018). Towards achieving food security in Nigeria: The economic strains and strategies for way forward. *Global Journal of Economics and Finance*, 2(1):7-23.
8. Asenso Okyere, K., Jemaneh, S. (2012). *Increasing agricultural productivity and enhancing food security in Africa: New challenges and opportunities*. International Food Policy Research Institute (IFPRI), Washington, USA.
9. Bello, M., Yahaya, J., Adamu, I. (2024). An analysis of sustainable agricultural productivity and food security in Nigeria. *Journal of Political Discourse*, 2(2):45-60.
10. Benson, T., Amare, M., Ogunniyi, A. (2020). *The relative commercial orientation of smallholder farmers in Nigeria: Household and crop value-chain analyses*. Working paper no. 66, International Food Policy Research Institute (IFPRI), Washington, USA.
11. Dawson, N., Martin, A., Sikor, T. (2016). Green revolution in Sub-Saharan Africa: Implications of imposed innovation for the wellbeing of rural smallholders. *World Development*, 78:204-218, <http://dx.doi.org/10.1016/j.worlddev.2015.10.008>

12. Fadare, O., Akerele, D., Mavrotas, G., Ogunniyi, A. (2019). *Effect of Conflict and Food Price Shocks on Calorie Intake and Acute Malnutrition in Nigeria: A Micro-Panel Data Analysis*. In: 93rd Annual Conference of the Agricultural Economics Society (AES), University of Warwick, Coventry, UK, conference paper, pp. 1-19, doi: 10.22004/ag.econ.289676
13. FAO (2018). *The State of Food Security and Nutrition in the World - 2018. Building climate resilience for food security and nutrition*. Food and Agriculture Organization of the United Nations (FAO), Rome, Italy.
14. Goldman, A. (1995). Threats to sustainability in African agriculture: Searching for appropriate paradigms. *Human Ecology*, 23:291-334, <https://doi.org/10.1007/BF01190135>
15. Hussayn, J., Gulak, D., Aboaba, K., Keshinro, O. (2020). Effects of Agricultural Commercialization on Poverty Status of Smallholder Cassava Farming Households in Oyo State, Nigeria. *Scientific Papers Series. Management Economic Engineering in Agriculture and Rural Development*, 20(4):255-265.
16. IFAD (2011). *International Fund for Agricultural Development - Annual Report 2011*. International Fund for Agricultural Development (IFAD), Rome, Italy, retrieved at: www.ifad.org/documents/38714170/39315751/annual+report+2011+english.pdf/397a0cf9-e4e1-49cc-9fee-3449e56f2d61, 15th January 2025.
17. Igwe, P., Rahman, M., Odunukan, K., Ochinanwata, N., Egbo, O., Ochinanwata, C. (2020). Drivers of diversification and pluriactivity among smallholder farmers: Evidence from Nigeria. *Green Finance*, 2(3):263-283, doi: 10.3934/GF.2020015
18. Manikas, I., Ali, B., Sundarakani, B. (2023). A systematic literature review of indicators measuring food security. *Agriculture & Food Security*, 12:10, <https://doi.org/10.1186/s40066-023-00415-7>
19. Manja, L., Zingwe, D., Kamangila, A. (2025). Smallholder farming commercialization and food security in Malawi: Do land rights and intrahousehold bargaining power matter? *Agriculture & Food Security*, 14(2), <https://doi.org/10.1186/s40066-025-00520-9>
20. Matemilola, S., Elegbede, I. (2017). The Challenges of Food Security in Nigeria. *Open Access Library Journal*, 4(12):4185, <https://doi.org/10.4236/oalib.1104185>
21. Mgbakor, M., Uzendu, P., Ndubisi, D. (2014). Sources of agricultural credit to small-scale farmers in Ezeagu local government area of Enugu state, Nigeria. *Journal of Agriculture and Veterinary Science*, 7(8):1-8.

22. Mgbenka, R., Mbah, E., Ezeano, C. (2016). A review of smallholder farming in Nigeria: Need for transformation. *Agricultural Engineering Research Journal*, 5(2):19-26, doi: 10.5829/idosi.aerj.2015.5.2.1134
23. Mgomezulu, W., Chitete, M., Maonga, B., Kachingwe, L., Phiri, H., Mambosasa, M., Folias, L. (2024). Does shifting from subsistence to commercial farming improve household nutrition and poverty? Evidence from Malawi, Tanzania and Nigeria. *Research in Globalization*, 8:100201, <https://doi.org/10.1016/j.resglo.2024.100201>
24. Michels, J., Zereyesus, Y., Beghin, J. (2024). Increasing sedentary time, minimum dietary energy requirements, and food security assessment. *Applied Economic Perspectives and Policy* (ahead of print), 1-25, <https://doi.org/10.1002/aep.13522>
25. Naz, S., Amin, H., Khan, J., Nawaz, F. (2023). Determinants of food security among rural households of developing countries: A systematic literature review. *Journal of Asian Development Studies*, 12(3):1-18.
26. NBS (2019). *Nigeria General Household Survey-Panel Wave 4 (2018/19)*. Nigerian National Bureau of Statistics, Abuja, Nigeria, retrieved at: <https://nigerianstat.gov.ng>, 11th February 2025
27. Obasan, T., Okojie, L., Okuneye, P. (2017). *Determinants of Rural Households' Food Security in Ogun State, Nigeria*. In: 18th Annual NAAE Conference, Abeokuta, Nigeria, proceedings, pp. 278-286.
28. Ochieng, S., Gödecke, T., Qaim, M. (2020). Agricultural Commercialization and Nutrition in Smallholder Farm Households. *Journal of Agricultural Economics*, 71(2):534-555, <https://doi.org/10.1111/1477-9552.12359>
29. Ogundele, O. (2020). Study on the Effects of Agricultural Practices on Economic Production. *Journal of Agricultural Economics*, 21(4):430-442.
30. Ojeleye, O., Adebisi, O., Fadiji, T. (2014). Assessment of farm household food security and consumption indices in Nigeria. *Asian Journal of Agriculture and Rural Development*, 4(9):458-464, doi: 10.22004/ag.econ.198426
31. Okon, U., Frank, N., Etowa, E., Nkeme, K. (2017). Household level food security status and its determinants among rural farmers in Akwa Ibom State, Nigeria. *Agricultural Science Research Journal*, 7(10):297-303.
32. Olanrewaju, E. (2016). Agricultural Commercialization: Effect on Food Security among Smallholder Farming Households in Southwestern Nigeria. *International Journal of Science and Research*, 5(11):1265-1269.

33. Olanrewaju, E., Adenegan, K., Alawode, O. (2016). Assessment of Crop Commercialisation among Smallholder Farming Households in Southwest Nigeria. *International Journal of Scientific Research in Science and Technology*, 2(6):478-486.
34. Oparinde, L., Aturamu, O., Ojo, O., Kulogun, O. (2020). Agricultural Commercialization and Food Security Nexus among Maize Farmers in Akure South Local Government, Ondo State, Nigeria. *Journal of Scientific Research and Reports*, 26(8):79-87, <https://doi.org/10.9734/jsrr/2020/v26i830297>
35. Otekunrin, O., Otekunrin, O., Sawicka, B., Pszczolkowski, P. (2021). Assessing food insecurity and its drivers among smallholder farming households in rural Oyo state, Nigeria: The hfias approach. *Agriculture*, 11(12):1189, <https://doi.org/10.3390/AGRICULTURE11121189>
36. Oyinloye, O., Akinola, O., Akande, Y., Akinyele, A., Mosimabale, M. (2018). Food Insecurity in Africa. *Journal of Humanities and Social Science*, 23(9):68-75, doi: 10.9790/0837-2309036875
37. Prince, A., Nzechie, O., Obiorah, J., Ehi, O., Idakwoji, A. (2023). Analyzing the critical impact of climate change on agriculture and food security in Nigeria. *International Journal of Agriculture and Earth Science*, 9(4):1-27, doi: 10.56201/ijaes.v9.no4.2023.pg1.27
38. Strasberg, P., Jayne, T., Yamano, T., Nyoro, J., Karanja, D., Strauss, J. (1999). *Effects of agricultural commercialization on food crop input use and productivity in Kenya*. MSU working paper no. 71, Michigan State University, Department of Agricultural Economics, East Lansing, USA.
39. Wudil, A., Usman, M., Rosak Szyrocka, J., Pilar, L., Boye, M. (2022). Reversing years for global food security: A review of the food security situation in Sub-Saharan Africa (SSA). *International Journal of Environmental Research and Public Health*, 19(22):14836, <https://doi.org/10.3390/ijerph192214836>