Insecurity'S Toll on Agriculture: Analyzing Nigeria'S Agricultural Productivity Challenges

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Abstract

Human existence depends on the stability of its surroundings and consistent access to food, both of which are essential for societal sustainability. This study examines how insecurity affects Nigeria's agricultural productivity between 1983 and 2021. It draws on the Cobb–Douglas production framework, the frustration–aggression perspective, and analytical conflict theory to explain the interaction between insecurity and productive capacity. Annual time-series data were compiled from the Central Bank of Nigeria (CBN) statistical bulletin, the National Bureau of Statistics, and the World Bank's development indicators. Descriptive statistics and econometric analyses, specifically the Pairwise Granger Causality test and the Vector Error Correction Model (VECM), were applied to test the hypotheses. Results indicate that insecurity does not directly cause changes in agricultural productivity during the study period. Nevertheless, insecurity exerts a statistically significant negative influence in the long run, while short-run effects appear weakly positive. The analysis also suggests that insecurity relates positively to food-security measures in both short- and long-term horizons. The study therefore recommends an integrated policy response that combines peacebuilding initiatives, conflict management, and strengthened security systems to create a stable environment for agricultural advancement.

Keywords

Insecurity, Agricultural Productivity, Nigeria, VECM

1. Introduction

Sustaining human life depends fundamentally on environmental stability and consistent food supply. Every society therefore relies on both security and agricultural productivity as essential conditions for its continued existence. Most Sub-Saharan African countries believe agricultural growth to be critical to economic development [1]. This is due to the fact in most Sub-Saharan African countries, agriculture remains a cornerstone of economic progress, supplying essential raw materials for industry, generating large-scale employment, and contributing foreign exchange earnings through exports. Agriculture, according to [2], is the main sphere of human activity concerned with the primary production of food and cash crops, livestock, fisheries, forestry, and product marketing. Agriculture's role in any economy is extensively described in the relevant literature for developing nations; it can promote economic development by improving food supply, releasing labor for industries, and extending the home market for export. It has the potential to increase the size of the domestic market for export.

Agriculture in Nigeria has been the most important sector of the economy based on the fact that our ancestors were sustained primarily on farming as their major occupation although it was with the aid of crude implements compared to what is obtained today. Yet, they were not just able to produce food crops such as yam, cassava, maize, millet, sorghum, and soya beans for their personal consumption so that there was no need for food importation, but Nigeria was considered the major exporter of agricultural products such as palm produce, cocoa, groundnut, cotton and rubber. Despite the limitation of using crude implements, they were able to respond accordingly to the demands of their times. However, despite the notable roles played by the agricultural sector in the economy, several factors still serve as an obstacle to the thriving of agricultural productivity in the economy, and among these factors is insecurity.

Nigeria has faced escalating levels of insecurity recently, marked by rising violence between communities. Over the last five years, approximately 77,000 people have lost their lives, and 2.6 million have been displaced [3]. Conflict has permeated every region, though the prevalence and intensity vary. Ethnic conflicts in the North, widespread kidnapping, particularly in the South-South and West, militancy and pipeline vandalism in the Niger Delta, terrorism by Boko Haram in the North East, and self-determination agitations by groups like IPOB and MASSOB have contributed to the overall insecurity [4].

Specifically, the Fulani herdsmen pose a significant threat to food production, violently harassing farmers in states like Benue, Gombe, and Taraba. In June 2017, Fulani herdsmen attacked communities in Taraba State, resulting in the death of about 732 people within four days [National Institute for Security Studies (NISS) [5]. The herdsmen not only invade and destroy farms but also intentionally allow their cows to graze on cultivated crops. This has led to farmers abandoning their farmland due to fear, causing a decline in agricultural output, exacerbating food shortages. The situation is further compounded by loss of life and rural-urban migration, adding to the challenges faced by the agricultural sector.

Although measures have been taken to address insecurity, such as the criminalization of terrorism, the establishment of vigilante groups, and improved surveillance, the killing, raping, and destruction of farmland continue to rise, raising concerns about food production. Bandit and herdsmen attacks on farmlands pose a threat to agricultural productivity and have ripple effects on economic activities, including high unemployment, low living standards, and increased rural-urban migration.

While existing research predominantly examines the relationship between insecurity and agricultural output or food security [6-8]. Given the critical role of agriculture in Nigeria's economy and the pervasive impact of insecurity, there is a pressing need to deepen the understanding of how insecurity specifically affects agricultural productivity. Therefore, a more nuanced analysis is required to capture the direct and indirect effects on productivity. Expanding this line of inquiry will provide valuable insights for policymakers and stakeholders, enabling the development of more targeted interventions to mitigate the adverse impacts of insecurity on Nigeria's agricultural sector. Moreover, previous studies have been region-specific [7-9], highlighting the need for a comprehensive analysis of the overall impact of insecurity on agricultural productivity nationwide to inform policymaking. Therefore, this study aims to fill this research gap by empirically analyzing the impact of insecurity on agricultural productivity in while also investigating the effect of insecurity on food security in Nigeria. The rest of this paper is structured as follows; while section 2 briefly reviews the theoretical and empirical literature, the methodology of the study is captured in section 3. Presentation and discussion of results is done in section 4, whereas section 5 features conclusion and policy recommendations.

2. Literature Review

2.1 Theoretical Framework

The theoretical foundation for understanding the nexus among insecurity, agricultural productivity, and food security is rooted in two key theories: Randall Collins' View-Analytical Conflict Theory and the Cobb-Douglas Production Theory.

2.1.1 Randall Collins' View-Analytical Conflict Theory

Randall Collins conducted an extensive analysis of modern complex organizations and social arrangements, drawing insights from influential theorists such as Marx, Max Weber, Durkheim, Mead, Schultz, and Goffman. He integrated perspectives from symbolic interactionism, ethnomethodology, and phenomenology. According to Collins, social interaction naturally contains elements of tension and competition. Power differentials and coercive capacities shape group relations, making conflict an inherent feature of organized society.

Collins, akin to other conflict theorists, contends that every society exhibits a differential distribution of desirables, including wealth, power, prestige, and other valuable goods. Inequalities create rank hierarchies, establishing graded levels of individuals with varying resource access. Continuous competition among groups or social strata ensues for a greater share of these desirables. Individuals, in this framework, seek to maximize their subjective status based on available resources and in competition with rivals. Collins observes that individuals are fundamentally pursuing their own interests, and situations involving power often result in inherently antagonistic interests. The core argument posits that individuals exist in self-constructed subjective worlds, others exert control over their subjective experiences, and conflicts frequently arise over control. Life is portrayed as an ongoing struggle for status, where awareness of others' power is essential. Assuming everyone utilizes available resources to enlist others' aid in presenting the best possible face under given circumstances becomes a guiding principle for interpreting various stratifications.

2.1.2 Theory of Cobb-Douglas Production Function

The Cobb–Douglas production framework, first developed by Charles Cobb and Paul Douglas in 1928, explains how output levels depend on the combination of production inputs, primarily labor and capital. The model remains widely applied because of its ability to represent how changes in input quantities translate into variations in total production. In its generalized form, the function can be represented as:

Q = f (K, L, P, H), where output (Q) is determined by the collective influence of capital (K), labor (L), and other possible factors such as land productivity (P) and human capital (H).

The simplified or standard Cobb–Douglas specification is expressed as:

$$Q(L, K) = AL^{\beta} K^{\alpha}$$

In this equation, A represents total factor productivity, while α and β denote the output elasticities of capital and labor respectively, and are parameters that are typically constrained between 0 and 1 to reflect diminishing returns to scale.β and α are constants between 0 and 1.

The Cobb-Douglas production function is a generic model that can be applied to various sectors, including agriculture. In the context of this study, if insecurity affects the efficiency of labor or disrupts the use of capital in agricultural activities, these effects could be captured in the production function. Insecurity might lead to labor shortages, increased costs of securing farms, or disruptions in the supply chain, all of which could influence agricultural productivity.

2.2 Empirical Literature

In the realm of contemporary socio-economic challenges, the interplay between insecurity and agricultural productivity, and food security takes center stage, demanding focused attention from researchers, policymakers, and stakeholders. The dynamic relationship between these economic conditions holds substantial implications for the stability and prosperity of nations. This empirical literature review seeks to delve into the multifaceted connections and dynamics that characterize the interface between insecurity, agricultural productivity, and food security.

Global insecurity, manifesting through insurgencies, terrorism, and communal conflicts, has become increasingly widespread, threatening both economic resilience and social stability across nations regardless of development status [10,11]. In the agricultural sector, empirical studies have shown that insecurity significantly affects agricultural productivity. The disruptions caused by insecurity, such as conflict, terrorism, and civil unrest, create an environment of uncertainty and fear that directly hampers various aspects of agricultural activities. Safety threats restrict farmers' ability to cultivate and manage resources such as land, water, and essential inputs, thereby constraining productivity. [12-14]. Population displacement and infrastructure destruction compound these effects, accelerating the fall in farm output and rural income [15]. studied how insecurity affects maize farming and its value chain in the local government. The research used both surveys and data analysis. The findings show that maize farming is profitable, but it has been seriously affected by the insurgency, leading to abandoned farmlands and forced migration. In a related investigation, [12] examined how insurgent activities influence agricultural growth and productivity in Nigeria. Using historical time-series data spanning 1960–2011, the analysis incorporated several indicators—such as the agricultural share of GDP, infant mortality rate, carbon emissions from fuel use, and food production levels—as measures of agricultural transformation. The study identified four major episodes of insecurity: the Nigerian civil war, Boko Haram insurgency, Niger Delta militancy, and Fulani herders' conflicts. Findings indicated that transitions from peaceful to violent periods produced marked declines in agricultural contributions to GDP—by approximately 17.6%, 19.5%, and 17.5% for the Boko Haram, Niger Delta, and Fulani herders' crises, respectively. Similarly, [16] conducted a study examining the effect of farming insecurity on farmers' motivation in Enugu State, Nigeria. The research, based on a cross-sectional design and employing statistical analysis, revealed that farming insecurity had a statistically significant negative effect on farmers' motivation. This finding suggests that insecurity in the agricultural sector can lead to reduced motivation among farmers, potentially affecting agricultural productivity. Insecurity disrupts planting and harvesting cycles, disrupts supply chains, and deters investments in the sector, leading to a substantial negative effect on overall agricultural productivity [17].

Persistent conflicts between pastoralists and crop cultivators impose heavy social and economic burdens on rural households, undermining agricultural productivity and community stability. These disputes generally emerge from competition for limited natural resources, particularly land and water, and are often intensified by cultural and economic differences. In one study, [13] analyzed the clashes between farmers in Benue State and Fulani herders, focusing on their socio-economic repercussions for affected households. Grounded in the dialectical-materialist perspective, which interprets human behavior through the interaction of economic interests and class dynamics, the researchers applied a cross-sectional survey design using both field data and structured questionnaires from 340 farmers who had experienced herder-related attacks. Regression results demonstrated that such violent encounters led to substantial declines in crop yields and farm income. Similarly, [18] assessed the farmer–herder crisis in Guma Local Government Area, Benue State, using purposive sampling of 160 farming families and 40 herders from conflict-prone zones. The study found far-reaching outcomes, including population displacement, destruction of assets, loss of life, and a significant contraction in agricultural production within the locality.

The state of national security strongly influences both food availability and accessibility, making societal peace essential for achieving sustainable household nutrition. Using panel data covering 2010–2016, [19] analyzed how variations in agricultural productivity relate to household food security outcomes in Nigeria. Their results showed that insecurity (compounded by environmental pressures such as climate instability and insufficient irrigation infrastructure) reduces farm productivity and, consequently, undermines food sufficiency. In a similar study, [20] explored how economic expansion and agricultural advancement affect food security within the country. Applying the Autoregressive Distributed Lag (ARDL) approach, the authors found that constraints on agricultural growth arising from insecurity significantly weaken food-system resilience and intensify vulnerability to food shortages. Similarly, [21] explored the impact of insecurity on agricultural food loss in Nigeria. Using time series data from 2011 to 2020, the study found a negative relationship between insecurity indicators (crime rate and unemployment rate) and agricultural productivity, thereby influencing food security. Insecurity can disrupt transportation and trade routes, making it difficult to transport food from farms to markets [22,23]. This disruption in supply chains can lead to shortages and increased prices,

affecting the overall availability of food. Insecure regions also experience a breakdown in market systems. Farmers may find it challenging to sell their produce, leading to financial losses and further contributing to food insecurity [21,23]. Collectively, prior evidence underscores the intricate feedback between conflict, farm productivity, and national food sufficiency. Understanding the impact of insecurity on agricultural output and its potential effects for economic development and individual or household-level food security is essential for policymakers aiming to establish resilient and stable food systems.

3. Methodology

3.1 Data and Variables

This research employs annual data for 1983–2021, a timeframe that captures the intensification of insecurity and its potential relationship with Nigeria's declining food security. In addition, the period is suitable for the available econometric method of data analysis. The main variables of interest include Terrorism index (TRI) a proxy for insecurity, Agricultural productivity (AGP), and Food Security index (FSI), a proxy for food security. Other control variables include Unemployment Rate (UMR), Food Price Index (FPI), and Government Expenditure on Agriculture (GEA), and Inflation Rate (INFR).

Agricultural Productivity is a measure of the amount of agricultural output produced for a given amount of inputs in Nigeria. For this study, AGP serves as a dependent variable. Data on agricultural productivity is obtained from Central Bank of Nigeria (CBN) statistical bulletin and serves as the dependent variable for first model but as a repressor for the second model.

Terrorism Index (TRI) **is** an index or rating system that assesses and quantifies the level of terrorism or political violence in Nigeria. Data on terrorism index is obtained from Global Terrorism database. Terrorism index is expected to have a negative effect on agricultural productivity. In areas experiencing conflict or insecurity, agricultural activities may be disrupted due to forced displacement, damage to infrastructure, and the inability of farmers to access their fields. This could lead to a decrease in agricultural productivity.

The Food Security Index (FSI) serves as a composite indicator reflecting the level of food accessibility within an economy, often linked to broader social and economic conditions. It integrates diverse socioeconomic and health-related measures into a single numerical value and is hypothesized to exert a positive influence on agricultural productivity in the first model. Information for this variable was sourced from the Central Bank of Nigeria (CBN) Statistical Bulletin. The Unemployment Rate (UNEMR) represents the share of the labour force that remains without work but is actively engaged in seeking employment opportunities and available for productive activity. For this study, Unemployment rate serves as an independent variable for the first model while data for UNEMR is gotten from CBN statistical bulletin. Government Expenditure on Agriculture in this study, entails actual expenditure (both capital and recurrent) geared towards the development of the agricultural sector in Nigeria. It Inflation Rate (INFLA) Inflation rate refers to the percentage increase in the average price level of goods and services in the Nigerian economy over a specific period of time, usually a year. It is a measure of how much the purchasing power of a Naira has changed over time.

3.2 Model specification

This study is premise on the impact of insecurity on agricultural productivity in Nigeria. The simple theoretical model for this study is adapted from the work of Ahmad [6]. The study will therefore use two models in accordance with objectives.

The first mode is specified in a functional form as:

$$AGP = F(INS) \quad (1)$$

Where

AGP= Agricultural Productivity

INS= Insecurity

However, the study shall use Security Terrorism Index (TI) as a proxy for insecurity. Therefore incorporating these and other variables, which are possible determinants of agricultural productivity, the model becomes

$$AGP_t = F(TI_t,\ UMR_t,\ GEA_t,\ FPI_t,\ INFLA_t) \quad (2)$$

The Econometric form of equation 2 can be specified thus:

$$AGP_t = \alpha_0 + \alpha_1 TI_t + \alpha_2 UMR_t + \alpha_3 GEA_t + \alpha_4 FPI_t + \alpha_5 INFLA_t + \varepsilon_t \quad (3)$$

In order to be able to capture the non-linear property and heteroscedasticity of the variables the above equation will be logged. Therefore. Taking the partial logarithm, equation 3 becomes

$$lnAGP_t = \alpha_0 + \alpha_1 TI_t + \alpha_2 UMR_t + \alpha_3 LnGEA_t + \alpha_4 FPI_t + \alpha_5 INFLA_t + \varepsilon_t \quad (4)$$

Where

AGP= Agricultural Productivity

TI = Terrorism Index (A proxy for Insecurity)

UMR = Unemployment Rate

GEA = Government Expenditure on Agriculture

FPI= Food Price Index

INFLA= Inflation Rate

Ln = Natural Logarithmic sign

t = Time period

ε_t = Stochastic error term at time t.

α_1 to α_5 are the coefficients to be estimated

α_1, α_2 and α_5 are expected to be negative while α_3 and α_4 are expected to be positive.

The second model is specified functionally as

$$FSI = F(INS) \quad (5)$$

Where,

FSI= Food Security Index (A proxy for Food Security)

INS= Insecurity

Incorporating this and other variables, which are possible determinants of food security, the model becomes

$$FSI_t = F(TI_t, \ AGP_t, \ INFLA_t) \quad (6)$$

The Econometric form of equation 6 can be specified thus:

$$FSI_t = \alpha_0 + \alpha_1 TI_t + \alpha_2 \ln AGP_t + \alpha_3 INFLA_t + \varepsilon_t \quad (7)$$

To address potential non-linearity and heteroscedasticity among the variables, the model was expressed in logarithmic form. Consequently, applying the natural logarithm transforms Equation 7 into:

$$\ln FSI_t = \alpha_0 + \alpha_1 TI_t + \alpha_2 Ln \ln AGP_t + \alpha_3 INF_t + \varepsilon_t \quad (8)$$

Where

FSI= Food Security Index

TI = Terrorism Index (A proxy for Insecurity)

AGP= Agricultural Productivity

INFLA= Inflation Rate

Ln = Natural Logarithmic sign

t = Time period

ε_t = Stochastic error term at time t.

α_1 to α_5 are the coefficients to be estimated

α_1 and α_3 are expected to be negative while α_2 is expected to be positive.

3.3 Method of Data Analysis

The dataset for the study was analyzed using standard econometric procedures. Initially, a unit root test was carried out to examine the stationarity characteristics of the variables, which guided the selection of the appropriate estimation approach. The Pairwise Granger Causality test was then applied to identify both the existence and direction of causal relationships among the variables. Following the outcomes of the stationarity analysis, the Vector Error Correction (VEC) model was adopted as the principal analytical framework to assess the influence of insecurity on agricultural productivity and food security in Nigeria. The VEC representation for the first model is expressed as follows:

$$\Delta TI_t = \beta_0 + \sum_{t=1}^{p} \beta_{1i}\Delta InAGP_{t-i} + \sum_{t=1}^{p} \beta_{2i}\Delta TI_{t-i} + \sum_{t=1}^{p} \beta_{3i}\Delta UMR_{t-i} + \sum_{t=1}^{p} \beta_{4i}\Delta \ln GEA_{t-i}$$
$$+ \sum_{t=1}^{p} \beta_{5i}\Delta FPI_{t-i} + \sum_{t=1}^{p} \beta_{6i}\Delta INFLA_{t-i} + \Omega_1 ECM_{t-1} + \mu_{1t}$$

(9)

$$\Delta UMR_t = \beta_0 + \sum_{t=1}^{p} \beta_{1i}\Delta \ln AGP_{t-i} + \sum_{t=1}^{p} \beta_{2i}\Delta TI_{t-i} + \sum_{t=1}^{p} \beta_{3i}\Delta UMR_{t-i} + \sum_{t=1}^{p} \beta_{4i}\Delta \ln GEA_{t-i}$$
$$+ \sum_{t=1}^{p} \beta_{5i}\Delta FPI_{t-i} + \sum_{t=1}^{p} \beta_{6i}\Delta INFLA_{t-i} + \Omega_1 ECM_{t-1} + \mu_{1t}$$

(10)

$$\Delta InGEA_t = \beta_0 + \sum_{t=1}^{p} \beta_{1i}\Delta InAGP_{t-i} + \sum_{t=1}^{p} \beta_{2i}\Delta TI_{t-i} + \sum_{t=1}^{p} \beta_{3i}\Delta UMR_{t-i} + \sum_{t=1}^{p} \beta_{4i}\Delta \ln GEA_{t-i}$$
$$+ \sum_{t=1}^{p} \beta_{5i}\Delta FPI_{t-i} + \sum_{t=1}^{p} \beta_{5i}\Delta INFLA_{t-i} + \Omega_1 ECM_{t-1} + \mu_{1t}$$

(11)

$$\Delta FPI_t = \beta_0 + \sum_{t=1}^{p} \beta_{1i}\Delta InAGP_{t-i} + \sum_{t=1}^{p} \beta_{2i}\Delta TI_{t-i} + \sum_{t=1}^{p} \beta_{3i}\Delta UMR_{t-i} + \sum_{t=1}^{p} \beta_{4i}\Delta \ln GEA_{t-i}$$
$$+ \sum_{t=1}^{p} \beta_{5i}\Delta FPI_{t-i} + \sum_{t=1}^{p} \beta_{5i}\Delta INFLA_{t-i} + \Omega_1 ECM_{t-1} + \mu_{1t}$$

(12)

$$\Delta INFLA_t = \beta_0 + \sum_{t=1}^{p} \beta_{1i}\Delta InAGP_{t-i} + \sum_{t=1}^{p} \beta_{2i}\Delta TI_{t-i} + \sum_{t=1}^{p} \beta_{3i}\Delta UMR_{t-i} + \sum_{t=1}^{p} \beta_{4i}\Delta \ln GEA_{t-i}$$
$$+ \sum_{t=1}^{p} \beta_{5i}\Delta FPI_{t-i} + \sum_{t=1}^{p} \beta_{5i}\Delta INFLA_{t-i} + \Omega_1 ECM_{t-1} + \mu_{1t}$$

(13)

The error correction model for the second model is specified as:

$$\Delta FSI_t = \beta_0 + \sum_{t=1}^{p} \beta_{1i}\Delta FSI_{t-i} + \sum_{t=1}^{p} \beta_{2i}\Delta TI_{t-i} + \sum_{t=1}^{p} \beta_{3i}\Delta \ln AGP_{t-i} + \sum_{t=1}^{p} \beta_{4i}\Delta INFLA_{t-i} + \Omega_1 ECM_{t-1} + \mu_{1t} \quad (14)$$

$$\Delta TI_t = \beta_0 + \sum_{t=1}^{p} \beta_{1i}\Delta FSI_{t-i} + \sum_{t=1}^{p} \beta_{2i}\Delta TI_{t-i} + \sum_{t=1}^{p} \beta_{3i}\Delta \ln AGP_{t-i} + \sum_{t=1}^{p} \beta_{4i}\Delta INFLA_{t-i} + \Omega_1 ECM_{t-1} + \mu_{1t} \quad (15)$$

$$\Delta AGP_t = \beta_0 + \sum_{t=1}^{p} \beta_{1i}\Delta FSI_{t-i} + \sum_{t=1}^{p} \beta_{2i}\Delta TI_{t-i} + \sum_{t=1}^{p} \beta_{3i}\Delta \ln AGP_{t-i} + \sum_{t=1}^{p} \beta_{4i}\Delta INFLA_{t-i} + \Omega_1 ECM_{t-1} + \mu_{1t} \quad (16)$$

$$\Delta INFLA_t = \beta_0 + \sum_{t=1}^{p} \beta_{1i}\Delta FSI_{t-i} + \sum_{t=1}^{p} \beta_{2i}\Delta TI_{t-i} + \sum_{t=1}^{p} \beta_{3i}\Delta \ln AGP_{t-i} + \sum_{t=1}^{p} \beta_{4i}\Delta INFLA_{t-i} + \Omega_1 ECM_{t-1} + \mu_{1t} \quad (17)$$

4. Result and discussion

4.1 Results of Descriptive Statistic

A concise overview of the statistical characteristics of the variables employed in the analysis is provided in Table 1.

Table 1. Descriptive Statistics of Variables

VARIABLES	AGP	TI	UMR	GEA	FPI	FSI	INFR
Mean	8021.688	8.127359	4.422051	21.56285	79.43046	68.65038	20.74086
Maximum	28028.85	9.118000	8.670000	72.27000	131.8844	103.2900	72.83550
Minimum	23.80000	7.350600	2.870000	0.012770	53.12230	25.35000	5.388008
Std.Dev.	9203.354	0.445802	1.701817	24.12091	23.93654	24.81161	17.09356
Skewness	0.839593	0.024760	1.880532	0.804530	0.736060	-0.27045	1.527465
Kurtosis	2.263300	2.244641	4.793718	2.280241	2.207030	1.831444	4.342954
Jacque-Bera	5.463893	0.931157	28.21493	5.049085	4.543403	2.694419	18.09619
Prob.	0.065092	0.627772	0.000001	0.080095	0.103137	0.259965	0.000118
Observation	39	39	39	39	39	39	39

Source: *Extract from Author's computation from E-views 10*

A careful examination of the 39 observations show that between 1983 and 2021, agricultural productivity(AGP), terrorism index(TI), unemployment rate(UMR), government expenditure on agriculture (GEA), food price index (FPI), food security index (FSI), and inflation rate (INFR) are averaged ₦8021.688 billion, 8.127359%, 4.422051%, ₦21.56285 billion, 79.43046%, 68.65038%, and 20.74086%respectively. Result from Table 5 indicate highest values of ₦28028.85 billion, 9.12%, 8.67%, ₦72.27000 billion, 131.88%, 103.3% and 72.8% for agricultural productivity, insecurity, unemployment rate, government expenditure on agriculture, food price index, food security index and inflation rate with corresponding minimum values of ₦23.80000 billion, 7.35%, 2.87%, ₦0.012770 billion, 53.12%, 25.35% and 5.39% respectively. The table also show that these values far from their mean values by ₦9203.354 billion, 0.445802%, 1.701817%, ₦24.12091 billion, 23.93654%, 24.81161%, and 17.09356% in that order, implying that these values are needed to bring the series closer to their mean scores. From the result, all the variables, except food security index, are positively skewed (to the right) indicating that the series (except food security index) is tilted towards large values. The table also review that all the variables (agricultural productivity, terrorism index, government expenditure on agriculture, food price index, food security index) are platykurtic i.e. having a peak shape except unemployment rate and inflation rate, which have flat shape (leptokurtic).

The Jarque-Bera statistic is used to measure the normality of the series. Results from Table1 indicate that agricultural productivity, terrorism index, government expenditure on agriculture, food price index, food security index are normally distributed since their probability values are greater than 0.05 (5%), while unemployment rate and inflation rate are not normally distributed, since their probability values are less than 0.05. Due to the non-uniformity of unit of measurement for the selected variables, natural logarithm is applied in order to unify the series so that the coefficients can be interpreted as elasticities and to account for the non-linear property and heteroscedasticity of the variables.

4.1.3 Unit Root Test

Time series data is generally considered stationary if its mean and variance are independent of time. If the time series is non-stationary, it implies that its mean and variance are changing over time. A time series data is said to have a unit root when it mean and variance changes over time. Stationarity is vital in econometrics as most times the series may exhibit unit root problem. If the time series is non-stationary, the regression will produce misleading results. A stationarity test is carried out in order not to run a spurious (misleading) regression. The ADF unit-root test was used for this analysis since it adjusts for serial correlation. Result of the ADF test are for the series is presented in Table 2 below

Table 2. Unit Root Test Result

Variables	At Levels			At 1ˢᵗ Differenc			Level of integration
	t-stat	Crit. value	Prob.(0.05) at 5%	t-stat.	Crit. value	Prob. (0.05)	
LOGAGP	2.103773	2.943427	0.2444	3.666531	2.943427	0.0089	I(1)
TI	1.782381	2.941145	0.3833	6.082933	2.943427	0.0000	I(1)
UMR	0.620411	2.941145	0.9885	4.881460	2.943427	0.0003	I(1)
LOGGEA	2.741243	2.945842	0.0771	8.586761	2.943427	0.0000	I(1)
FPI	0.860432	2.941145	0.7898	5.215175	2.943427	0.0001	I(1)
FSI	1.616722	2.945842	0.4639	3.592627	2.951125	0.0112	I(1)
INFLA	1.609850	1.949856	0.1003	6.277883	2.945842	0.0000	I(1)

Source: *Extract from Author's computation from E-views 10*

(*) indicate 5% levels of significance at which the variables are stationary. Again, I(0) indicate that the variable is stationary at levels while I(1) shows that the variable is stationary at first difference.

Result from Table 2 shows that all the variables in the series were not stationary at levels, but became stationary at first difference, that is LogGAP, TI, UMR, LogGEA, FPI, FSI, and inflation are integrated of order one. This result provides favourable conditions to fulfill the requirements for the use of Vector Error Correction Model (VECM) to examine the effect of insecurity on agricultural productivity in Nigeria. The short and long-run dynamics preposition serves as detection of disequilibrium error whenever they exist and provide information on how long it would take to correct them. For the result to be consistent with theory, it is required that the coefficient VECM be negative and significant and lies between 0< ECM <1

4.3 Optimal Lag selection criteria

Economic theory has it that the dependence of one variable (in this case agricultural Productivity) and on other variables (in this case insecurity and other regressors) is rarely instantaneous. Most often, the regressand responds to the regressor(s) within a lapse of time and hence there exists a lag between the response time. The result of the various lag length selection criteria is presented in the next table.

Table 3. Optimal Lag Length Selection Criteria

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-560.7292	NA	50162.13	30.68806	30.99283	30.79551
1	-357.7619	318.1648*	12.79316*	22.36551	24.80366*	23.22507*
2	-306.8466	60.54801	15.52685	22.26198*	26.83350	23.87365

Source: *Extract from Author's computation from E-views 10*

The result of the lag length selection criteria presented in Table 3 indicates that LR, FPE, SC, and HQ suggest for one (1) lag while the AIC suggests for two (2) lags. Since the majority of the criteria suggest one (1) lag, the model will be estimated using one (1) lag for optimal performance and adequate representation of data.

4.4 Cointegration Result

The cointegration result shows how variables trend in the long run. It is typically a technique for modelling the long-run relationships between or among the study variables. The test is conducted under the null hypothesis that there is no co-integrating equation. The trace statistic and Max-Eigen statistic is estimated and the result is presented in the table below

Table 4. Trace Statistic Result

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.892988	257.5681	125.6154	0.0000
At most 1 *	0.855170	177.1148	95.75366	0.0000
At most 2 *	0.771985	107.5559	69.81889	0.0000
At most 3 *	0.485638	54.33553	47.85613	0.0109
At most 4 *	0.335378	30.40170	29.79707	0.0426
At most 5 *	0.246490	15.69438	15.49471	0.0467
At most 6 *	0.141820	5.505887	3.841466	0.0189

Source: *Extract from Author's computation from E-views 10*

(*) indicates rejection of the null hypothesis at 0.05 critical level

The trace statistic result in Table 4 indicates that there are seven (7) co-integrating equations in the model at 0.05 level, hence the evidence of long-run relationship among the study variables. We, therefore, reject the null hypothesis, as the values of the Trace statistic are greater than the critical values with their probability values less than 5% level. Furthermore, the Max-Eigen result is also presented in the table below to prove the incidence of cointegration.

Table 5. Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.892988	80.45332	46.23142	0.0000
At most 1 *	0.855170	69.55894	40.07757	0.0000
At most 2 *	0.771985	53.22033	33.87687	0.0001
At most 3	0.485638	23.93383	27.58434	0.1370
At most 4	0.335378	14.70732	21.13162	0.3099
At most 5	0.246490	10.18849	14.26460	0.1998
At most 6 *	0.141820	5.505887	3.841466	0.0189

Source: *Author's Computation from E-views 10*

(*) indicates rejection of the null hypothesis at 0.05 critical level

Result from the Max-eigenvalue test as presented in Table 5 indicates that there are three cointegration equations in the model at the 0.05 level. This is because their Max-eigenvalue value is greater than the critical value at 5% level of significance. The asterisk sign denotes the presence of three cointegrating equations and the rejection of the null hypothesis at the 0.05 level. Thus, the null hypothesis of there is no cointegration equation (r =0) is rejected implying that there is a long-run behavioral relationship between the time series variables.

4.5 Causal Relationship between Insecurity and Agricultural Productivity in Nigeria

The Granger causality test is a statistical hypothesis test for determining whether one time series is useful in explaining another. The test shows the direction of causality between and among the study variables, i.e. Log AGP, TI, UMR, LogGEA, FPI, FSI, and INF in Nigeria, judging at 5% level of significance. The study therefore employed the Pairwise Granger Causality Test to uncover the direction of causality among the study variables and within the scope of the study. The results are presented in Table 6 below

Table 6. Pairwise Granger Causality Test Result

Null Hypothesis:	Obs	F-Statistic	Prob.
TI does not Granger Cause LOGAGP	36	0.01406	0.9977
LOGAGP does not Granger Cause TI		0.66017	0.5832
UMR does not Granger Cause LOGAGP	36	0.11829	0.9486
LOGAGP does not Granger Cause UMR		0.61916	0.6082
LOGGEA does not Granger Cause LOGAGP	36	9.23224	0.0002
LOGAGP does not Granger Cause LOGGEA		0.48707	0.6939
FPI does not Granger Cause LOGAGP	36	0.67768	0.5728
LOGAGP does not Granger Cause FPI		0.93902	0.4345
FSI does not Granger Cause LOGAGP	36	0.25559	0.8567
LOGAGP does not Granger Cause FSI		3.79577	0.0207
INFLA does not Granger Cause LOGAGP	36	1.03449	0.3919
LOGAGP does not Granger Cause INFLA		1.05441	0.3835
FSI does not Granger Cause TI__	36	0.63036	0.6013
TI does not Granger Cause FSI		1.60621	0.2094

Source: *Extract from Author's computation in E-views 10*

Table 6 shows the summary of the causal relationship among the variables. The decision rule is that if the probability value is less than 5% (0.05) level of significance, we reject the null

hypothesis and say that there is a causal relationship among the concerned variables, otherwise, we fail to reject. The table revealed that there is no causal relationship between agricultural productivity and insecurity in Nigeria during the study period as the probability values of 0.9977 and 0.5832 (forward and backward direction) are more than 0.05 threshold. The implication is that during the study period, insecurity is not capable of influencing agricultural productivity in Nigeria and hence there is no feedback effect from agricultural productivity. The absence of a causal link between insecurity and agricultural productivity could be because of regional variations inherent in Nigeria. Nigeria is a diverse country with regional variations in terms of security challenges and agricultural practices. It is possible that the causal relationship between insecurity and agricultural productivity varies across different regions within Nigeria.Analyzing national-level data may obscure the regional dynamics at play. More so, the causal relationship between insecurity and agricultural productivity could operate with a time lag. It is possible that the effects of insecurity on agricultural productivity take longer than the period covered in this study to manifest and become visible. This finding contradicts that of [6] and [14] who found a significant negative causal link between insecurity and agricultural output in Nigeria.

Table 6 also reveals that there is no causality between agricultural productivity and the unemployment rate in Nigeria during the period under study. The null hypothesis that there is a causal relationship (forward and backward) between agricultural productivity and the unemployment rate is rejected as the probability values of 0.9486 and 0.6082 are greater than the 0.05 threshold. This could be because of structural factors and Sectoral imbalances. Nigeria's labor market and agricultural sector during this period were influenced by structural factors and sectoral imbalances that limit the causal relationship between agricultural productivity and unemployment. Factors such as skill mismatches, limited access to capital and technology, inadequate infrastructure, or the dominance of subsistence farming could contribute to the decoupling of agricultural productivity and employment outcomes. More so, the result shows a uni-directional causality running from government expenditure on agriculture to agricultural production, with no feedback from the latter. The unidirectional causality suggests that the government's agricultural policies and investments heavily influenced agricultural production during the study period. The government may have prioritized allocating resources and funding to the agricultural sector to enhance productivity and promote food security. This finding aligns with [12], who established that government spending on agriculture significantly drives improvements in agricultural output in Nigeria.

There is also a uni-directional causality from agricultural productivity to food security in Nigeria during the study period. A possible explanation for this result may be the fact that agricultural productivity serves as the primary source of food production in Nigeria. When agricultural productivity increases, it leads to higher yields of crops, livestock, and fisheries, resulting in a greater supply of food in the market. This, in turn, enhances food availability and contributes to improved food security. However, the result revealed no causality between food security and insecurity in Nigeria during the study period. This rather contradictory result may be due to time lag and lagged effects. It is possible that the study period was not long enough to capture the full extent of the causal relationship. Insecurity-related disruptions might have long-term consequences on agricultural productivity and food security that extend beyond the study period. The finding corroborates [21], who observed that productivity gains reduce food losses and enhance food availability.

4.6 The Long-run Effect of Insecurity on Agricultural Productivity in Nigeria

Having established that there is cointegration among the variables incorporated in the model, the Johansen cointegration test result was obtained to investigate the long-run impact of insecurity on agricultural productivity in Nigeria as presented in the table below

Table 7. Normalized Johansen Cointegration Test result

Normalized cointegrating coefficients (standard error in parentheses)					
LOGAGP	TI	UMR	LOGGEA	FPI	INFLA
1.000000	2.582184	0.482347	0.002220	-0.006336	-0.012432
	(0.76344)	(0.05191)	(0.06973)	(0.00318)	(0.00384)

Source: *Author's computation from E-views*

The result from Table 7 reveals that in the long run, insecurity (represented as Terrorism index) has a negative but significant effect on agricultural productivity in Nigeria. Since the Johansen cointegration test result allows the interpretation of the coefficients in reverse form, a 1% increase in insecurity will lead to a 2.58% decrease in agricultural productivity in the long run. This result conforms to theoretical expectations. Insecurity, such as armed conflicts, terrorism, or high crime rates, can disrupt agricultural production activities. Farmers may face difficulties in accessing their farmlands, machinery, and inputs due to safety concerns. Displacement of rural populations or destruction of infrastructure can also hinder agricultural productivity. This finding aligns with [6], who reported that insecurity exerts a significant and persistent negative impact on agricultural output in Nigeria, particularly through disruptions in farm operations and rural displacement.

The result from Table 7 also reveals that in the long run, unemployment has a negative and significant effect on agricultural productivity. This finding is in line with theory and aligns with [11], who found that high unemployment constrains agricultural development in Nigeria. One explanation for this is that of skill mismatch. If the unemployed individuals lack the necessary skills or training for agricultural work, their presence in the labor market may not contribute positively to productivity. This could be the case if the agricultural sector requires specific expertise or technological expertise that the unemployed workforce does not possess. There is, however, a negative but insignificant effect of government expenditure on agriculture on agricultural productivity in the long run as opposed to theory. This surprising result could be attributed to poor implementation and monitoring mechanisms on funds allocated for agricultural development. The ineffective implementation may result from corruption, bureaucratic inefficiencies, and inadequate capacity within government agencies responsible for agricultural development. Insufficient monitoring and evaluation systems can prevent timely corrective measures, limiting the effectiveness of government spending. Other control variables in the study (such as Food Price Index and inflation rate) are found to positively affect agricultural productivity in Nigeria. It is also worth noting that this result is strictly under the ceteris paribus assumption, as these estimates are only OLS estimates.

4.7 Error Correction Result

This study also looked at the short-run impact of insecurity on agricultural productivity in Nigeria. The ECM results are presented in the table below:

Table 8. Error Correction Result of Insecurity on Agricultural Productivity

Variables	Coefficient	Std. Error	t-statistic
D(LOGAGP(-1))	0.386688	0.17107	2.26044
D(TI(-1))	0.037409	0.25395	0.14731
D(UMR(-1))	-0.037830	0.06733	-0.56185
D(LOGGEA(-1))	-0.036128	0.03591	-1.00599
D(FPI(-1))	0.001880	0.00283	0.66353
D(INFLA(-1))	0.002741	0.00186	1.47653
ECM(-1)	-0.008981	0.05008	-0.17933

Source: *Author's computation from E-views 10 Output*

The error correction result in Table 8 shows the negative coefficient of the error correction term

(-0.008981). This means that the previous years' deviation from long-run equilibrium is corrected at an adjustment speed of 0.9%. In other words, in the case of any initial distortions, the system will converge towards long-run equilibrium at a speed of 0.9% within the year. The result from the table also indicates that insecurity has a positive but insignificant effect on agricultural productivity. Specifically, a percentage increase in insecurity is associated with a 0.037% increase in agricultural productivity in the short run. Surprisingly, the short-run estimates of insecurity on agricultural productivity contradict economic theory. This result could be attributed to the fact that in the short run, insecurity in Nigeria temporarily creates price incentives for agricultural produce due to disrupted supply chains, reduced market competition, or increased demand for locally produced goods. Higher prices can motivate farmers to increase production in the short term to capitalize on these favorable market conditions, leading to a temporary boost in agricultural productivity. Table 8 also reviewed that in the short run, a 1% increase in the unemployment rate and government expenditure on agriculture will result in 0.038% and 0.036% decrease in agricultural productivity respectively in Nigeria. Other control variables such as food price index and inflation were found to have a positive short-run effect on agricultural productivity in Nigeria during the study period.

4.8 The effect of Insecurity on Food security in Nigeria.

The study also examined the effect of insecurity on food security in Nigeria. Results of the normalized Johansen Cointegration test and Error Correction test are presented in the tables below;

Table 9. Normalized Johansen Cointegration Test Result

Normalized cointegrating coefficients (standard error in parentheses)			
FSI	TI	LOGAGP	INFLA
1.000000	-1.257910	-9.853294	-0.112284
	(6.38137)	(1.20679)	(0.05935)

Source: *Author's computation from E-views 10 Output*

The result of the Johansen cointegration test presented in Table 9 shows that in the long run, insecurity (represented by terrorism index), agricultural productivity, and inflation rate have a positive effect on food security in Nigeria during the study period. The Johansen cointegration test result allows the interpretation of the coefficients in reverse form. Going by this, a percentage increase in insecurity is associated with a 1.26% increase in food security in the long run. It is surprising that this is against theoretical expectations. This result also contradicts the findings of [7] and [9], who both established that insecurity and herder–farmer conflicts significantly reduce food availability through displacement and farmland abandonment. However, the possible explanation for this contradicting result in the Nigerian context could be the fact that in the face of insecurity, communities developed strong social bonds and cooperation mechanisms that facilitated collective action in agriculture. This enhanced social cohesion could lead to coordinated efforts, shared resources, and increased productivity, ultimately improving food security outcomes.

Going forward, agricultural productivity was found to have a positive effect on food security in the long run. This result is in line with economic theory as improved agricultural productivity leads to increased food production, which contributes to greater food availability in the country. Higher crop yields, enhanced farming techniques, and technological advancements expand the quantity and variety of food produced, thereby positively impacting food security. This finding aligns closely with that of [21] whose findings revealed that greater agricultural efficiency reduces food losses, thereby reinforcing food security outcomes. As against economic theory, inflation was also found to have a positive effect on food security in the long run. This could be attributed to the fact that during this period, the government implemented several agricultural programs and policies to enhance food security. In response to inflationary pressures, the Nigerian government implemented policies and programs aimed at boosting agricultural production and ensuring food security. These programs include Operation Feed the Nation (which was in full swing in the 1980s), National Agricultural Insurance Scheme (NAIS) in 1987, Agricultural Promotion Policy (APP) in 2016, Anchor Borrowers' Program (ABP) in 2015. Such measures helped in mitigating the negative effects of inflation on food security and contribute to long-term improvements.

Table10. Error Correction Result of Insecurity on Food Security

Variables	Coefficient	Std. Error	t-statistic
D(FSI(-1))	-0.608790	0.15609	-3.90034
D(LOGAGP(-1))	0.100736	4.71575	0.02136
D(TI(-1))	5.992416	4.63659	1.29242
D(INFLA(-1))	-0.025628	0.04143	-0.61860
ECM(-1)	-0.090395	0.08785	-1.02893

Source: *Author's computation from E-views 10 Output*

The error correction result in Table10 shows the negative coefficient of the error correction term

(-0.090395). This means that the previous years' deviation from long-run equilibrium is corrected at an adjustment speed of 9%. The table further revealed that insecurity has a positive but significant effect on food security in the short run. More specifically, a percentage increase in terrorism index will yield 5.99% increase in food security in the short run. This result is contrary to theoretical expectation. This could be accounted for by the fact that during this period, heightened insecurity drew the attention of the government to the significance of agriculture and food security as critical national issues. This increased awareness resulted in the allocation of resources, policy initiatives, and interventions to enhance agricultural productivity and mitigate the adverse impacts of insecurity on food availability. In addition, agricultural productivity is found to exert a positive but insignificant effect on food security in the short run. This is theoretically plausible as higher agricultural productivity enables farmers to have surplus produce that can be sold in markets, both locally and nationally. This increased market access improves the availability and accessibility of food, benefiting both rural and urban populations and contributing to improved food security. In line with theory, inflation was revealed to have a negative but insignificant impact on food security in the short run.

4.9 Post Estimation Test

A diagnostic check was carried out in order to establish whether the model is valid. In other words, if the model developed has a problem or not. Residual tests were conducted to examine whether estimates are reliable and residuals

have exhibited a distribution that can be considered normal and whether estimates can yield reliable statistical inferences.

Table 11. Diagnostic Test Results

Test	Statistic	Probability
Residual normality	2.303366	0.3161
Breusch-Godfrey heteroskedasticity	853.6435	0.3642
LM Serial Correlation,	1.353349	0.1633

Source: *Extract from Authors' computations in E-views 10*

Based on the data provided in Table 11, the test statistic used to examine serial correlation, along with its associated probability value, suggests that there is insufficient evidence to reject the null hypothesis, indicating that there is no serial correlation. Likewise, the test statistic for heteroskedasticity does not provide enough evidence to reject the null hypothesis, indicating the absence of heteroskedasticity. The residual normality test indicates that the residuals do not violet the classical assumptions of the Ordinary Least Squares and are likely to produce unbiased results. This is because the probability value (0.3161) of the normality test is greater than the 5% threshold.

5. Conclusion and Recommendation

Based on the findings documented in this study, the study concludes that there is no causal relationship between insecurity and agricultural productivity in Nigeria during the period under study. The study also submits that in the long run, there is a negative and significant effect of insecurity on agricultural productivity in Nigeria, even though the effect may be seen in the short run. Generally, the study establishes that in Nigeria, the positive direction of insecurity on agricultural productivity can be felt only in the long run and that insecurity does not exert a negative influence on food security in Nigeria. The study therefore provides the following recommendations

First, on the basis of no causality between insecurity and agricultural productivity in Nigeria, the study recommends a multi-dimensional approach to understanding the impact of insecurity on agricultural productivity. Insecurity can manifest in different forms, such as conflict, theft, or resource disputes. Analyze the specific dimensions of insecurity and their potential impact on agricultural productivity, including the role of social, economic, and political factors.

It is also necessary to conduct further research to gather more comprehensive and detailed data on the relationship between insecurity and agricultural productivity in Nigeria. This could involve longitudinal studies, case studies in specific regions, or the collection of more granular data at the farm level. A deeper understanding of the dynamics between insecurity and agricultural productivity can help identify any hidden or complex relationships.

On the long-run effect of insecurity on agricultural productivity, the study recommends that government should strengthen agricultural support systems, such as extension services, farmer-training programs, access to credit, and market linkages. These interventions can help farmers build resilience to insecurity and enhance their productivity. Additionally, targeted support for areas disproportionately affected by insecurity can help mitigate its impact on agricultural productivity. There is also a need to encourage diversification of income sources for farmers to reduce their reliance solely on agriculture.

This can provide alternative means of livelihood during periods of insecurity and mitigate the long-run impacts on agricultural productivity. The government should also address the root causes of insecurity through peace-building efforts and conflict resolution mechanisms. Promote dialogue and engagement among stakeholders to foster peaceful environments that are conducive to agricultural activities. This can involve collaborations with local communities, government agencies, and non-governmental organizations working in conflict-affected areas.

Finally, regarding the effect of insecurity on food security in Nigeria, despite the perceived positive impact, it is crucial to address the underlying causes of insecurity to achieve sustainable food security. Efforts should focus on conflict resolution, peacebuilding, and improving security measures to create a conducive environment for agricultural development.

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