Agricultural Financing and Food Security in Nigeria: A Strategy for Achieving Sustainable Development Goals (SDGs)

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Abstract

The study examined the contribution of agricultural financing to food security in Nigeria. The study scope was annual data from 1981 to 2022, sourced from the Central Bank of Nigeria Statistical Bulletin, 2022, and World Bank Data Indicators, 2022. Food security was measured using the food production index. At the same time, agricultural financing is proxied with government expenditure on agriculture, deposit money banks (DMB) credit to agriculture, and agricultural sector guarantee scheme fund loans to agricultural sector. The study also introduced interest rates and agrarian output into the model. It utilized the autoregressive distributed Lag (ARDL) model as the main estimation technique and found that government expenditure on agriculture and agricultural sector guarantee credit scheme loans to the agricultural sector have a negative influence on food security in Nigeria, while deposit money banks (DMBs) credit to agriculture is found to influence food security in Nigeria detrimentally. The study recommended that government expenditure on agriculture should be channeled towards the rural region of the country, and credit for agricultural purposes should be given to the peasant farmers who engage in small-scale farming in Nigeria.

Keywords: Agriculture finance, Food security, Food production index & Sustainable financing.

Introduction

In light of the world's growing population, climate change, and the increasing strain on natural resources, the need to ensure global food supplies is more critical than ever. The World Bank estimates that every 1% increase in food cost drives 10 million people into extreme poverty (FAO, 2022). If food prices stay this high for a year, global poverty might climb by more than 100 million people (World Bank, 2022). The growing global food demand is a concern for humanity (Osabohien *et al*., 2020).

There is a significant ongoing debate about the best approach to keeping up with global population growth and increasing food production to meet the United Nations (UN) Sustainable Development Goal 2 (achieve food security at all levels, improve nutrition for all, and promote sustainable agriculture) by 2030 (Osabohien *et al.*, 2020). A multifaceted strategy is needed to attain food security, which is the availability, use, and accessibility of wholesome food to fulfill everyone's nutritional requirements. The development and implementation of sustainable agricultural practices, which are closely linked to the availability of essential financial resources, are a crucial aspect of this strategy.

Sustainable agricultural financing is the process and resource provision that helps promote and maintain the use of sustainable farming methods. This covers a range of financial tools, including investment vehicles, grants, loans, and insurance, that are intended to promote and ease the shift to sustainable agriculture. Sustainable agricultural financing catalyzes change by tackling the financial obstacles encountered by farmers, enabling the broader implementation of ecologically sustainable and socially responsible farming methods. With the decrease in global biodiversity, our capacity to discover new food sources is being restricted. Additionally, most evaluations fail to provide information on the whole range of food resources eaten worldwide. As a result, the need for science-based policymaking has become crucial.

Sustainable agriculture financing and food security are inextricably linked. As sustainable methods promote agricultural system resilience, they contribute to higher yields, higher food quality, and better stability in the face of climate-related issues. Furthermore, the incorporation of sustainable agriculture finance guarantees that farmers, particularly smallholders, who make up a sizable proportion of the global agricultural labor force, have the means to adopt and sustain these practices. Globally, sustainable agricultural finance is increasingly seen as a necessity for achieving not only food security but also larger sustainable development goals (Cláudia *et al*., 2022). International organizations, governments, and financial institutions must work together to create and implement policies that encourage sustainable agriculture finance, recognizing its critical role in solving the interconnected concerns of poverty, climate change, and food security.

With the world's population predicted to exceed 10 billion by 2050, mankind is progressively confronting a double burden of malnutrition, with one end of the spectrum experiencing a calorie shortfall (hunger) and the other experiencing an excess (Wells *et al*., 2021). Addressing these challenges will necessitate an increase in global food production, which cannot be accomplished by simply expanding industrial agriculture at the expense of the surrounding environment and shifting to healthier diets (Wells *et al*., 2021). This is a complicated scenario since there is a need to maintain the sustainable production of safe and nutritious food while also protecting biodiversity to offer other goods and ecosystem services that are directly and indirectly critical for human well-being.

Various strategies have been proposed by the government and stakeholders at all levels to improve food production; one of these strategies is based on the need to increase farmers' access to agricultural finance (credit) in order to increase productivity, while others focus on agricultural diversity (Osabohien *et al*., 2020a). Due to a lack of credit and machinery, food cultivation and production in Africa are mostly subsistence-based and characterized by poor technological know-how and intensive human resources (labor-intensive) (Osabohien *et al*., 2020a). It is vital to promote social adaptation to environmental changes caused by climate change, which might affect food production and people's livelihoods (Agriculture and Food Organization [FAO], 2019).

Understanding the global distribution of edible plants provides an opportunity to identify future crops that are better adapted to current and future climatic conditions and have locally accessible plant material. This has the potential to increase food security by promoting the cultivation of "climate-smart" crops with fit-for-purpose seed lots (Diazgranados *et al.*, 2020) that will yield food despite changing growing conditions.

The overall number of edible plants in the world varies from 100 (Van Wyk, 2019) to >30,000 plants, including infraspecific taxa (Diazgranados *et al*., 2020). These numerical discrepancies are due to a variety of factors, including taxonomic rank (e.g., counting infraspecific taxa), correctness (e.g., using reconciled taxonomy), and precision (e.g., employing a unique taxonomic backbone), as well as consumer kinds and diets. RBG Kew, for example, has recorded 7,039 edible species in a wide taxonomic sense from 288 families and 2,319 genera to date, including 7,030 edible species of Bryophyta, Chlorophyta, Rhodophyta, and Tracheophyte (Diazgranados *et al*., 2020).

Evidence suggests that wars and conflicts are the most significant global sources of food insecurity (Well *et al*, 2021). Indeed, 139 million people were in crisis or severe food insecurity in 24 countries and territories in 2021, with war and instability being the main causes (GRFC, 2024). Agriculture knowledge and innovation not only contribute significantly to food security and sustainability, but they are also critical to achieving the various SDG 2 goals of eradicating hunger, achieving food security and improving nutrition, and promoting sustainable agriculture (SDGs, 2024).

Adopting sustainable farming practices is crucial not just for ecosystem preservation but also for ensuring the agricultural sector's long-term viability. Global agricultural development agendas are increasingly focused on modern technology, such as green revolution hybrid and genetically modified (GM) crops, yet evidence that these technologies work for smallholder farmers is sparse.

Notwithstanding multiple attempts to relieve global hunger, food insecurity and under nutrition remain severe issues in many nations. One of the most significant barriers is the financial burden associated with shifting from conventional to sustainable farming methods. Farmers frequently face obstacles such as high upfront expenditures for eco-friendly technologies, restricted loan availability, and a lack of financial incentives (Sharma *et al*, 2024). The function of sustainable agriculture finance in this setting is critical.

Various finance scholars (Qiong *et al*, 2021; Ladha *et al*, 2020) have written about the Sustainable Development Goals (SDGs) from various points of view. Some say that the SDGs are consistent with the notion of sustainable financial flows, but others are opposed. Agriculture must not be treated lightly to fulfill the United Nations' SDGs, particularly objective number two. As a result, the purpose of this research is to investigate the contribution of agricultural financing to food security in Nigeria. When farm funding is not maintained, the country's food security goals would be threatened. Food security issues in a country can lead to a variety of undesirable outcomes, including child malnutrition. Severe food insecurity could lead to famine and, eventually, an unfavorable political environment to govern the country. In the worst-case scenario, food insecurity might spark a civil war. Sustainable agriculture finance has emerged as a promising strategy for promoting sustainable agriculture practices and increasing access to finance for smallholder farmers and agribusinesses. As a result, discussions about sustainable agriculture finance and food security are critical.

Conceptual Review

Agroecology

Agroecology is a farming strategy that mimics natural ecosystems by prioritizing biodiversity and soil health and limiting external inputs. Adoption of agroecological techniques in the context of sustainable agriculture financing needs financial mechanisms that support farmers in transitioning to and sustaining these environmentally friendly methods (Rizzo, 2024). Agroecology not only improves sustainability, but it also helps to ensure long-term food security. In agriculture, it highlights the relevance of biodiversity, soil health, and social justice. Crop diversification, integrated pest management, and agroforestry are examples of sustainable agriculture methods promoted by agroecology. It also underlines the importance of improving sustainable agriculture through local knowledge and participatory techniques.

Green Bonds for Sustainable Agriculture

Green bonds are financial securities that are particularly developed to support environmental initiatives. The idea of green bonds in the context of sustainable agricultural financing comprises issuing green bonds to generate funds for initiatives promoting sustainable farming techniques. These bonds enable investors to support ecologically sustainable agriculture, illustrating an increasing trend of financial markets complementing sustainability ideals.

Theoretical Review

This study is anchored on the Market-Based Theory. According to the market-based theory which was popularized by Kotler in 1967, building a viable market for sustainably produced agricultural commodities is important to the success of sustainable agriculture financing. This notion says that by developing and maintaining market ties that value and reward environmentally friendly practices, farmers would be more encouraged to engage in sustainable techniques to fulfill market needs. Sustainable agricultural product certification systems, consumer awareness programs, and cooperation between sustainable producers and market intermediaries all contribute to the formation of a viable market for sustainable agricultural commodities. Market-based theory is a relevant approach to sustainable agriculture since it encourages the use of market mechanisms to reward sustainable behaviors and increase the economic viability of sustainable agriculture. Specifically, market-based strategies may aid in addressing the market imperfections—such as pollution, incomplete information, and public goods—that often result in unsustainable farming practices. By internalizing the costs and benefits of sustainable agriculture, market-based systems may generate economic incentives for farmers to adopt more sustainable practices and boost their profitability.

Financial Incentives Theory: Financial incentives theory, often known as economic incentives theory, is a relevant approach to sustainable agriculture that stresses the necessity of giving financial incentives to farmers to promote the adoption of sustainable methods. The hypothesis was first presented by economist Elinor Ostrom (Investopedia, 2024), who suggested that financial incentives might play a significant role in encouraging sustainable resource management. The financial incentives hypothesis implies that farmers are rational agents who would embrace sustainable practices provided they are financially rewarded for doing so. This may include compensation for ecosystem services, subsidies for sustainable practices, and tax incentives for environmentally-friendly enterprises. Financial incentives may also assist to cover the expenses of converting to sustainable agriculture, which can be a barrier for certain farmers.

Empirical Review

Academic and policy circles have increasingly focused on the link between sustainable agricultural financing and food security. Sustainable agricultural financing is crucial to maintaining food security, which is a global concern. According to the Food and Agriculture Organization (FAO), around 690 million people remain hungry, underlining the significance of enhancing sustainable agriculture financing to boost food security (FAO, 2021). The purpose of this literature review is to analyze the empirical data on sustainable agricultural financing and food security.

Osabohien *et al* (2020a) research studied how agro-financing affects food production in Nigeria supporting Goal 2 of the 2030 Sustainable Development Goals (SDGs) which seeks to "end hunger, achieve food security, improve nutrition, and promote sustainable agriculture". The analysis covers the period 1981–2018 utilizing yearly data provided by the World Development Indicators (WDI) of the World Bank, Central Bank of Nigeria (CBN) Statistical Bulletin. The Johansen and the Canonical Cointegration techniques are applied and results suggest that agro-financing is statistically significant in explaining the amount of food production in Nigeria. The finding shows that a 1% increase in farmers' access to agricultural financing is related to an increase in food output of 0.002%–0.006% depending on the model setting. This result aligns with the 'a priori' expectations as it is expected that more agro-funding at low-interest rates motivates farmers to secure high-yield seedlings, machinery, and other farm implements, and organic inputs that positively impact total agricultural yield, leading to more food production. Therefore, the report suggests that more finance be supplied to the agricultural sector with less rigorous lending criteria, and more arable land be granted for farming reasons amongst others.

Tijjani *et al* (2022) evaluated the influence of different forms of agricultural funding on food security in Nigeria using time series data that cover a period from 1981 to 2020. To accomplish the research, the Autoregressive Distributed Lag (ARDL) Model was applied to evaluate the data. Food security in Nigeria was envisaged as food availability proxied by agricultural productivity in Nigeria. As such, agricultural production government spending on agriculture, inflation, and interest rate as the independent variables. The research utilized time series data from 1981 to 2020. The estimated ARDL model revealed commercial bank loans to agriculture, agricultural credit guarantee scheme funds, government spending on agriculture, and interest rates had a substantial effect on food security assessed by agricultural production. Consequently, to increase food security in Nigeria, this research advised among others that commercial banks should be encouraged to divert their credit to agriculture, and the government should offer additional guarantees on loans to assist farmers in obtaining credit. Finally, to boost access to food, efforts should be made to raise the per capita income of the people in other to fulfill the demand for food.

According to Adeshina *et al* (2020), the Agricultural sector which used to be the backbone of the Nigerian economy in the 1950s, 60s, and early 70s is now seen as a hazardous and unprofitable endeavor by financial institutions and government. This is because the financial institutions prefer to offer financing to other sectors where payback time is short and the return rate is high and also because the agricultural industry is poorly financed by the government owing to low budgetary allocation to the Agricultural sector throughout the years. The research studied the influence of Agricultural Financing on Economic Performance in Nigeria throughout the sampling period of 1978-2017. The research particularly tried to examine the influence of Agricultural Financing on Economic Performance in Nigeria. The research which used data from secondary sources from the Central Bank of Nigeria statistics bulletin was evaluated utilizing the Unit root test, Bound Cointegration test, and error correction modeling to empirically estimate the coefficient of parameter estimations. The statistical judgment of the analysis is based on a 5% (0.005) level of significance. From the result, it was deduced that in the long run, Agricultural Credit Guarantee Scheme Fund (ACGSF) is the most influential agricultural financing variable (as compared to government expenditure on agriculture and commercial bank credit to agriculture) that contributed to economic performance, as it revealed that (ACGSF) had a strong positive impact on the growth rate of the Nigerian economy. The research found and firmly maintained that Agricultural Financing contributed negatively to the economic performance of Nigeria during the sampling period largely because of insufficient financing.

Orji *et al* (2020) examined the causal relationship between agricultural funding and agricultural production growth in Nigeria. The data were largely gathered from Central Bank of Nigeria statistics bulletins and World Bank Economic Indicators and the research utilized the Pairwise Granger Causality test. The study demonstrated that there was no causal relationship between agricultural finance and agricultural production increase during the period under examination. The research by Eno *et al* (2023) investigated the link between Agricultural Financing and Agricultural Output in Nigeria. The effect was assessed through the relationship between Agricultural Gross Domestic Product (AGDP) and Banks‟ Credit to Agriculture (BCRA) together with Banks‟ Lending Rate proxied by Interest Rate (INTR), Foreign Exchange Rate (FREX), and Government Expenditure on Agriculture (GEXA) for the period 2011 – 2021. A highly trustworthy econometric tool (Ordinary Least Square –OLS) regression approach and error correction models were utilized to examine the impact/level of association between the dependent variable and each of the independent variables. The findings of the investigation demonstrate that banks' loan to the agriculture sector was appropriately signed and considerable (0.06167). This simply implied a positive association existed between Banks' lending and Agricultural production in Nigeria. High-interest rates reduce agricultural loan demand by farmers, lowering agricultural production in Nigeria (-0.00577). The research indicated that agriculture finance contributed to the economic performance of Nigeria during the sampling period because of insufficient funding.

Zhang *et al* (2020) believed that sustainable agricultural financing may increase food security and alleviate poverty among smallholder farmers in China. The research demonstrated that sustainable agriculture financing led to higher agricultural output, income, and food security among smallholder farmers. The research also indicated that sustainable agricultural financing decreased poverty and increased living conditions in rural regions.

Thiam *et al* (2020) believed that sustainable agricultural financing may boost food security and contribute to poverty reduction in Sub-Saharan African nations. The research concluded that sustainable agricultural financing allowed smallholder farmers to invest in technology and practices that increased their productivity, income, and food security. The research also indicated that sustainable agricultural financing offered employment and income possibilities in rural regions, hence contributing to poverty reduction. However, research by Bourgeois *et al* (2020) reveal that sustainable agricultural financing has problems in Sub-Saharan African nations, including restricted access to money, a lack of infrastructure, and inadequate governance.

Ouedraogo *et al* (2020) in a study aimed to address the problem of low adoption rates of sustainable agriculture practices among smallholder farmers in Burkina Faso tested variables such as credit access, extension services, and sustainable agriculture practices. The result of the study suggested that access to credit and extension services can enhance smallholder farmers’ adoption of sustainable agriculture practices, thereby contributing to food security.

Empirical scholarly studies by Jena *et al* (2020) demonstrated that sustainable agricultural techniques and financing may boost smallholder farmers’ income and food security in India. The research aimed to address the issue of low income and food insecurity among smallholder farmers in India. The factors evaluated were sustainable agricultural techniques, sustainable agriculture financing, income, and food security.

Satriawan *et al* (2020) indicated that sustainable agricultural financing may boost smallholder farmers’ productivity, income, and food security in Indonesia. The research aimed to solve the issue of poor productivity, income, and food insecurity among smallholder farmers in Indonesia. The factors evaluated were sustainable agriculture financing, productivity, income, and food security.

Adeleye *et al* (2020) investigated whether there is a causal relationship between agro-financing and economic growth based on empirical evidence. Adeleye et al concluded that a bi-directional causal relationship exists using the Granger test for causal analysis. To put it another way, proper and considerable investment in agriculture results in good economic growth. Simultaneously, economic expansion increases the demand for agricultural investment. If the immediate impact of financing is insufficient to improve agriculture, a long-term solution that can trigger the requisite goods in the industry may be required.

In addition, sustainable agricultural financing may strengthen the resilience of the food system to shocks such as pandemics. According to Phillips *et al* (2021), the COVID-19 pandemic has underscored the need to strengthen food system resilience to shocks. The authors pointed out that sustainable agricultural approaches may increase food system resilience by minimizing dependency on external inputs such as seeds and fertilizers. As a consequence, investment in sustainable agricultural financing may increase food system resilience to shocks such as pandemics and food security. The use of sustainable financing methods may promote agricultural sustainability.

Afolabi *et al* (2022) research assessed how agricultural financing affects Nigeria's economic progress. The research focused on the beneficial impact that optimal support of the agricultural sector could have on agricultural production and Gross Domestic Product (GDP). The research employed time series data and the Autoregressive Distributed Lag (ARDL) model. According to the study's results, Nigeria's high economic development tendency was primarily owing to the agricultural sector's availability of adequate capital. The study recommended that all government entities practice good corporate governance and transparency and that there should be coordination among the various governmental levels, financial institutions that accept deposits, foreign intervention agencies, and donor organizations because doing so will improve the efficiency and effectiveness of the agricultural sector's ability to access funding. This study aims to provide a reliable research contribution to the field in order to rectify the imbalance in the literature about the discussion and impact of sustainable agriculture finance.

Methodology

The data used were drawn from the Central Bank of Nigeria Statistical Bulletin, 2022, and World Bank Data Indicators, 2022. The study's scope is from 1981 to 2022, which is forty-two (42) years scope. The study focused on how food security is affected by agricultural financing in Nigeria. Food security was measured using the food production index, which measures the physical availability of food, while agricultural financing is proxied with government expenditure on agriculture, DMB credit to agriculture, and an agricultural sector guarantee scheme fund loan to agricultural sector. The study also introduced interest rate and agricultural output into the model. The study utilized autoregressive distributed lag (ARDL) as the main estimation technique while also estimating other necessary pre- and post-estimation tests. The model for the study was adapted from the study of Okorie and Chikwendu (2022); the model is presented in equation 1.

FPI = *f*(GEA, DCA, AGS, INT, AGO)…………………………………………………………..(1)

where:

FPI is the food production index, GEA is government expenditure on agriculture, AGS is the agricultural sector guarantee scheme fund loan to the agricultural sector, INT is the interest rate, and AGO is the agrarian output.

The model is represented in an ARDL form in equation 2.

$$\Delta \ln FPI_t = \alpha_0 + \sum_{i=1}^{m} \alpha_1 \Delta \ln FPI_{t-1} + \sum_{i=0}^{n} \alpha_2 \Delta \ln GEA_{t-1} + \sum_{i=0}^{p} \alpha_3 \Delta \ln DCA_{t-1} + \sum_{i=0}^{p} \alpha_4 \Delta \ln AGS_{t-1} + \sum_{i=0}^{n} \alpha_5 \Delta \ln INT_{t-1} + \sum_{i=0}^{p} \alpha_6 \Delta \ln AGO_{t-1} + \theta ECM_{t-1} + \varepsilon_t \qquad (2)$$

Where:

α_0 = constant
$\alpha_1 - \alpha_6$ = regression coefficients
ε_t = stochastic error term

Result of the Findings

Table 1: Descriptive Statistics

	FPI	GEA	DCA	AGS	INT	AGO
Mean	67.00000	129.8491	192.6138	3.220109	0.453578	8511.762
Median	66.62000	50.26068	48.56150	0.728545	4.310292	2015.422
Std. Dev.	27.41717	161.4309	317.8070	3.898679	14.25917	11183.50
Skewness	-0.057563	1.301974	2.293070	0.856914	-2.717477	1.378496
Kurtosis	1.835870	3.547754	8.304850	2.297717	12.91104	4.007211
Jarque-Bera	2.337774	12.09600	84.00576	5.860276	218.2694	14.71810
Probability	0.310713	0.002363	0.000000	0.053390	0.000000	0.000637

Source: Authors' Computation, 2024.

The descriptive statistics in Table 1 indicate that all the variables have a positive mean and median coefficient; this suggests that all the variables have an increasing tendency. FPI and AGO have a mean coefficient greater than their standard deviation; thus, FPI and AGO observations are grouped around the mean while GEA, DCA, AGS, and INT have a mean coefficient lesser than their standard deviation; thus, GEA, DCA, AGS, and INT observations are spread out from the mean. All the variables are positively skewed except for FPI and INT, which are skewed negatively. FPI and AGS are platykurtic variables while GEA, DCA, INT, and AGO are leptokurtic variables. The Jarque-Bera probability value shows that FPI and AGS are normally distributed while GEA, DCA, INT, and AGO are not normally distributed.

Table 2: Unit Root Test (Phillip-Peron)

At Level						
	LFPI	LGEA	LDCA	LAGS	LINT	LAGO
t-Statistic	-3.4947	-1.3878	-1.2488	-0.9302	-7.3403	-2.2122
Prob.	0.0133	0.5789	0.6439	0.7684	0.0000	0.2052
	**	n0	n0	n0	***	n0
At First Difference						
	d(LFPI)	d(LGAE)	d(LDCA)	d(LAGS)	d(LINT)	d(LAGO)
t-Statistic	-8.0793	-6.5343	-7.7596	-5.6785	-25.2137	-4.1320
Prob.	0.0000	0.0000	0.0000	0.0000	0.0001	0.0024
	***	***	***	***	***	***
Integration Order	I(0)	I(1)	I(1)	I(1)	I(0)	I(1)

(**) Significant at the 5%; (***) Significant at the 1% and (no) Not Significant

Source: Authors' Computation, 2024.

Table 2 presents the result of the unit root test using Phillip-Peron Test. The output of the test shows that FPI and INT are stationary at level (I(0)) while GEA, DCA, AGS, and AGO are stationary at first difference (I(1)). Thus, all the study's variables do not suffer from unit root. The mixed integration order serves as the basis for employing the use of ARDL.

Table 3: ARDL Bound Test

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	10.76595	10%	2.26	3.35
K	5	5%	2.62	3.79
		2.5%	2.96	4.18
		1%	3.41	4.68

Source: Authors' Computation, 2024.

The bound test estimated to determine the presence of a long-run relationship is presented in Table 3. The F-stat has a coeffect of 10.76595 which is greater than the upper and lower bounds values of 2.62 and 3.79 at the 5% significant value; this serves as an indication of the presence of a long-run relationship in the model.

Table 4: Long and Short Run Effects

Long Run Effects				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
LGAE	-0.070533	0.048584	-1.451771	0.1772
LDCA	0.568483	0.262422	-2.166293	0.0555
LAGS	-0.214487	0.086509	-2.479372	0.0326
LINT	0.004290	0.002780	1.543281	0.1538
LAGO	0.921188	0.336201	2.739993	0.0208
Short Run Effect				
C	0.079980	0.009349	8.554892	0.0000
D(LFPI(-1))	-0.642327	0.097430	-6.592683	0.0001
D(LGAE)	-0.005483	0.005301	-1.034310	0.3254
D(LGAE(-1))	-0.029801	0.005873	-5.074680	0.0005
D(LDCA)	-0.007087	0.018912	-0.374738	0.7157
D(LDCA(-1))	-0.139808	0.029283	-4.774372	0.0008
D(LAGS)	0.003251	0.012556	0.258949	0.8009
D(LAGS(-1))	0.006442	0.010877	0.592211	0.5669
D(LINT)	-0.001133	0.000173	-6.553967	0.0001
D(LINT(-1))	0.000451	0.000200	2.259297	0.0474
D(LAGO)	-0.123007	0.034123	-3.604774	0.0048
D(LAGO(-1))	0.220232	0.030109	7.314451	0.0000
CointEq(-1)*	-0.297385	0.030211	-9.843450	0.0000
R-squared	0.960112			
Adjusted R-squared	0.904270			
Durbin-Watson stat	2.534737			
F-statistic	17.19322			
Prob(F-statistic)	0.000001			

Source: Authors' Computation, 2024.

The result of the long-run effects shows that GEA and AGS have detrimental effects on FPI to the tune of -0.070533 and -0.214487, respectively; this suggests that 1 unit growth in GEA and AGS will lead to a 0.070533 and 0.214487 decline in FPI, respectively. DCA, INT, and AGO all express a favorable effect on FPI to a degree of 0.568483, 0.004290, and 0.921188, respectively; thus, an increment in DCA, INT, and AGO by 1 unit will result in a 0.568483, 0.004290, and 0.921188 unit increase in FPI, respectively.

The short-run effects indicate that GEA, DCA, INT, and AGO all hurt FPI, suggesting that an increase in GEA, DCA, INT, and AGO will lead to a reduction in FPI. Conversely, AGS expressed a positive effect on FPI; this means that growth in AGS will result in growth in FPI. The p-value shows that only INT and AGO effects are statistically significant. At lag one FPI, GEA, and DCA all have a negative effect on FPI at present, while AGS, INT, and AGO have beneficial effects on FPI at present. The CointEq(-1) has a coefficient of -0.297385 and a significant p-value; this indicates that there is a short run relationship in the model. It also indicates that around 29 percent of the short-run inconsistencies are being rectified and integrated into the long-run equilibrium relationship. The coefficient of determination suggests that 96% of the variation in FPI in the short run are caused by the regressors. The DB Watson shows the absence of autocorrelation. The F-stat p-value shows that the model is fit and the regressors are fit to be regressed on FPI.

Table 5: Autocorrelation Test

Autocorrelation	Partial Correlation		AC	PAC	Q-Stat	Prob*
		1	0.082	0.082	0.2712	0.603
		2	0.112	0.106	0.7852	0.675
		3	0.063	0.047	0.9544	0.812
		4	0.060	0.042	1.1134	0.892
		5	0.031	0.013	1.1574	0.949
		6	0.005	-0.012	1.1585	0.979
		7	-0.059	-0.069	1.3237	0.988
		8	-0.046	-0.043	1.4309	0.994
		9	-0.144	-0.131	2.5003	0.981
		10	-0.144	-0.117	3.6073	0.963
		11	-0.100	-0.052	4.1628	0.965
		12	-0.108	-0.059	4.8346	0.963
		13	-0.057	-0.008	5.0289	0.975
		14	-0.089	-0.050	5.5231	0.977
		15	-0.076	-0.049	5.9047	0.981
		16	-0.077	-0.065	6.3130	0.984

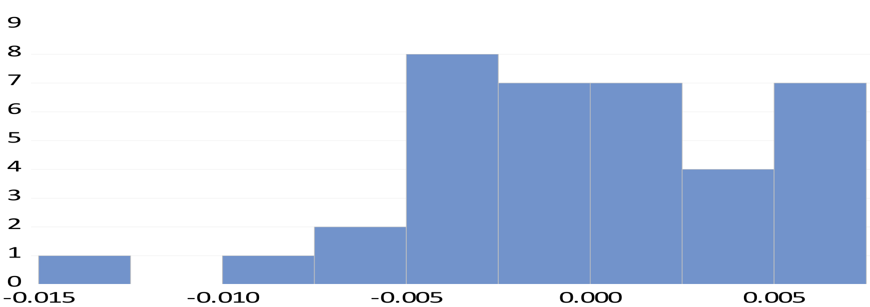
*Probabilities may not be valid for this equation specification.

Source: Authors' Computation, 2024.

The study passed the autocorrelation test with all p-value greater than 0.05 significance level, which means that the model's residuals do not suffer from auto-correlation.

Figure 1: Normality Test

Figure 1: Normality Test



Series: Residuals	
Sample 1985 2021	
Observations 37	
Mean	6.34e-17
Median	-0.000139
Maximum	0.007490
Minimum	-0.012548
Std. Dev.	0.004741
Skewness	-0.346305
Kurtosis	2.881940
Jarque-Bera	0.761040
Probability	0.683506

Figure 1: Normality Test

Source: Authors' Computation, 2024.

The residuals of the study are normally distributed, this is deduced from the Jarque-Bera p-value of 0.683506 which is greater than 0.05 significance level.

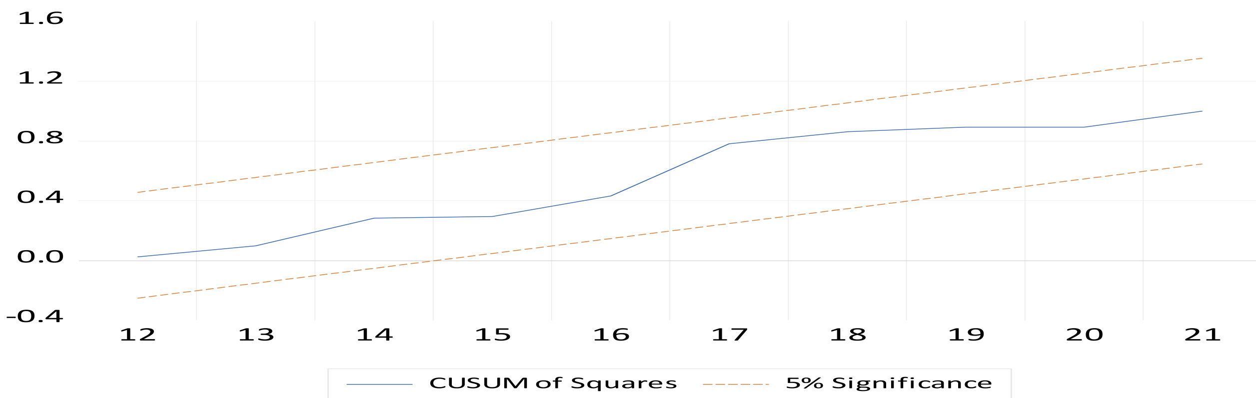


Figure 2: Stability Test

Source: Authors' Computation, 2024.

The CUSUM line stability test shows that all model is stable, this is a result of the CUSUM not straying out of the 5% significance line.

Table 6: Multicollinearity Test

Variable	Coefficient Variance	Uncentered VIF
LGAE	0.000323	3.369821
LDCA	0.000753	6.740184
LAGS	0.000397	3.755255
LINT	5.82E-07	1.273486
LAGO	0.000648	8.227002

Source: Authors' Computation, 2024.

The multicollinearity test shows that all the variables are indecent of each other, this conclusion is drawn as the VIF coefficient of the variables are all less than 10.

Discussion

The outcomes of the research reveal that government investment in agriculture has a lower impact on the food productivity index in Nigeria. Thus, government spending is not a desirable funding option for maintaining food security in Nigeria. DMBs loan to agriculture is revealed to have an increasing effect on the food productivity index in Nigeria. Thus, loans from DMBs to agriculture are likely to increase food security in Nigeria. The farm loan guarantee system is shown to have a lowering influence on the food productivity index in Nigeria. Hence, the farm credit guarantee plan has not been an effective financing alternative for ensuring food security in Nigeria. The research of Zhang *et al* (2020) concurred with the impact of DMBs credit to agriculture on food security; this is also confirmed by the results of Thiam *et al* (2020).

Conclusion

The study looked into how food security is influenced by the agriculture financing options in Nigeria. The study measured food security with food productive index while agriculture financing was proxied with government expenditure on agriculture, DMBs credit to agriculture, agricultural sector guarantee scheme fund loan to agricultural sector. The study used ARDL as its primary estimation technique. The study scope was limited to annual data from 1981 to 2022; which is a forty-two (42) years' scope. Food security was measured using food production index; while agricultural financing is proxied with government expenditure on agriculture, DMB credit to agriculture, Agricultural sector guarantee scheme fund loan to agricultural sector. The study found that government expenditure on agriculture and agricultural sector guarantee scheme fund loan to agricultural sector have negative influence on food security in Nigeria while DMBs credit to agriculture is found to influence food security in Nigeria detrimentally.

Recommendations

The following recommendations were made based on the findings of this study:

i. The government should diversify funding sources for agriculture. Given the limited impact of government investment, it's recommended to explore alternative funding mechanisms for agriculture. These could include a public-private partnerships (PPPs), securing a donor funding from international organizations or bilateral donors and issuing bonds specifically for agricultural projects that can attract private investment.

ii. The government should strengthen financial inclusion in rural areas. To enhance the impact of bank loans on agriculture, efforts should be made to improve financial inclusion in rural areas.

iii. Invest in Agricultural Research and Extension Services. To improve agricultural productivity, greater emphasis should be placed on agricultural research and extension services. Providing technical assistance to farmers, including training on modern agricultural practices and access to information.

iv. Infrastructure Constraints should be addressed. Inadequate infrastructure can hinder agricultural development. Therefore, investments should be made on rural roads connectivity between rural areas and markets, expansion of irrigation facilities to mitigate the impact of climate variability, building warehouses and cold storage facilities to reduce post-harvest losses.

v. Implementation of effective food security policies by developing a comprehensive food security strategies programs aimed at improving food production, distribution, and access.

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