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Banking Sector Credit and Agricultural Output in Nigeria

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Abstract

This study uses the Autoregressive Distributed Lag (ARDL) method to look at how bank loans affected agricultural production in Nigeria. The investigation made use of a yearly time series dataset that encompasses the entire period from 1981 to 2023, inclusive. While the agricultural sector enjoyed some short-term benefits from the loans and advances made available by deposit money banks, the sector as a whole reaped huge benefit in the long run. Loans and advances provided by deposit money banks to the agricultural sector have significant and favourable consequences in the short and long term. Government investment in capital projects also increased agricultural output, both immediately and over the long term, according to the results. The agricultural output in the crop's subsector was positively and substantially impacted by the consumer price index, both in the short and long term. Both the consumer price index and population expansion had a beneficial and lasting impact on the agricultural output of the cattle subsector. In addition, it was shown that annual rainfall significantly reduced agricultural productivity over time but had a big beneficial effect on output in the short term. The government ought to prioritise expanding access to affordable agricultural financing in order to promote the expansion of crops, animals, and overall agricultural production in the long run. Government spending on agricultural infrastructure and support services should be maintained or increased by policymakers in order to sustainably increase agricultural output.

Background to the Study

The domestic economy stands to gain a great deal from higher agricultural production. Economic growth and the reduction of poverty depend on it. Most of the country's poorest citizens reside in rural areas and work in the fields; agriculture is also the most important industry in the country. Over 36% of the workforce is employed by this industry, and approximately 84% of all jobs are created by it, according to Magaji, Usman and Yusuf (2023) and Oyelade (2019). This sector is crucial to the expansion and improvement of the economy, and it also happens to be the largest employer in the nation (Oyaniran, 2020). By expanding the supply of consumable food and fibre, the industry helps the expansion process along. The needs of an expanding population can be satisfied in this way.

Further benefits include a reduction in domestic spending, an increase in domestic investment, and the reallocation of surplus manpower to manufacturing. In addition, the agricultural sector can help save foreign currency by reducing reliance on imported goods or by earning it through exports. This allows them to quickly import industrial technology by accumulating an extra capital reserve. According to Ogbuabor and Nwosu (2017) and Udoka, Mbat and Duke (2016), wage-goods prices go down and real incomes and demand for domestic goods go up because of the agriculture sector's reputation for producing cheaper non-tradable agricultural items. There are four main divisions within Nigeria's agricultural sector, as there are in other countries. Agriculture, cattle (production and animal health), aquaculture, forests, and fisheries and aquaculture (including capture fisheries) are the subsectors.

The crops' subsector encompasses a wide variety of crops, including cereal grains, sugarcane, cotton, rice, sunflower, rapeseed, mustard, cottonseed, onion, chilli, and potato. Crops such as cotton provide the raw materials used by the textile industry. Nigeria, like any other country, can benefit economically by exporting rice. Both rice and wheat are essential commodities for human survival. A cash crop, sugarcane is essential to the production of sugar and goods derived from sugar. In addition to playing a crucial role in overall economic growth, the livestock sub-sector also serves to create foreign income. Domestic demand for meat, dairy, and eggs is met by this sector of the economy. For small-scale farmers and the rural poor without access to land, the livestock subsector is a potential lifesaver when it comes to reducing poverty. When it comes to reducing poverty and ensuring food security, the fishing subsector is crucial. Furthermore, it contributes to the economy and helps bring in money from exports. The loss of forests, which are considered an important part of the environment, could have serious societal and economic consequences for the generations to come (Chandio, Yuansheng, and Magsi, 2016). Out of all the output in this sector, crop production is by far the largest at around 87.6 percent. At 8.1%, the livestock subsector follows, followed by fishing at 3.2% and forestry at 1.1%. The importance of bank sector lending cannot be ignored by Nigeria, a nation that is in critical need of an agricultural rebirth.

One important part of every economy is the financial sector. As a subset of the larger financial services industry—which also includes asset management, insurance, venture capital, and private equity—it is what Hall (2023) considers it to be, while others may take a broader view. A cost is incurred by the banking sector as it transfers funds from the surplus spending unit to the direct spending unit. Because of its role as a go-between for new technologies, the banking industry is crucial. Identifying and backing good investors and applying innovative production processes are the main means of generating output growth (Innocent, Ademola and Glory, 2019). The sector also guarantees optimal allocation of savings. It is possible that bank credit will play a pivotal role in maintaining output growth activities. Credit from the banking industry can let investors invest more quickly and with more capital than they have on hand. Many investors would have to put their growth plans on hold permanently or indefinitely if they could only use their own funds (Rodríguez and Chávez, 2023). Banks' interest income improves as a result of businesses increasing their production, productivity, and efficiency thanks to the availability of bank loans. According to Rodríguez and Chávez (2023) and Innocent, Ademola and Glory (2019), the financing and stimulation of economic viability in the modern economy is what makes it a credit economy, which in turn guarantees growth and development in production.

Credit from the banking sector is essential for agricultural output since it allows for investment, innovation, and efficient operation, all of which are necessary for high agricultural output. Access to, availability of, and proper management of financing are critical to the success of sustainable agricultural growth. Inputs like seeds, fertilizers, machinery, and irrigation systems can't be purchased without farmers' access to finance. Farmers are able to invest in these inputs and significantly boost agricultural productivity because banking credit provides the necessary finances. Higher yields and more efficient farming operations can be achieved when farmers have access to loans that allow them to apply modern agricultural techniques and technology. These include precision agriculture, improved seed varieties, and advanced irrigation technologies. With the right kind of funding, farmers may diversify their operations, which increases agricultural output and makes it more stable. Extension programs that teach farmers how to maximize their yields through the use of credit are a great way to boost agricultural output. The working capital needed to keep farming activities going until harvest is sold can also be provided by loans from the banking sector. This keeps agricultural output steady by avoiding interruptions brought on by issues with money flow. (Ruiz, 2014; Ngong, Onyejiaku, Fonchamnyo, and Onwumere, 2023; Magaji, Usman, and Yusuf, 2023).

Statement of the Problem

Although it was not entirely dedicated during the oil discoveries, the government has since demonstrated interest in the expansion of the agricultural sector. The government has demonstrated its interest in a number of ways, including increased investment in irrigation and automation systems, the establishment of river basins, agricultural financing institutions, training, the activation and funding of extension programs, and the delivery of physical infrastructure. Through direct interventions and regulatory measures, banks have been encouraged to lend more money to the agricultural sector. The ACGSF was founded in 1977. It is an agricultural credit guarantee scheme. A program that provides low-interest loans to commercial agricultural businesses for extended periods of time was established in 2009 under the name Commercial Agriculture Credit Scheme (CACS). To aid farmers in increasing agricultural output, the Anchor Borrowers' Programme (ABP) was established in 2015 to supply them with inputs and finance.

The Nigeria Incentive-Based Risk Sharing System for Agricultural Finance (NIRSAL) is one of several programs that were put in place in 2013 to help banks with agricultural financing by giving them incentives, technical help, and risk-sharing facilities. The Agricultural Credit Support Scheme (ACSS) is one of several programs that are helping to increase agricultural output in the nation. This program provides low-interest loans to agro-allied businesses and farmers, with rates as low as 8%. Micro, Small, and Medium Enterprises Development Fund (MSMEDF) and other development finance interventions and regulatory measures are also in play. In 2019, for example, banks are required to lend a minimum of 65% of their deposits to agriculture under the Loan-to-Deposit Ratio (LDR) Policy.

It still hasn't lived up to its promise, despite numerous attempts and measures, even though it has become better in recent years. With a GDP contribution of just around 24–25%, the industry has clearly not grown at the same rate as the economy as a whole. Crops like as cocoa, palm oil, and rubber have seen their production fall over the years, and overall, productivity per hectare is low when compared to worldwide norms. Domestic production falls short of demand, leading to growing imports, particularly in recent times. Livestock and fisheries have also been suboptimal, with difficulties like bad breeds, inadequate nutrition, and infections. Other reasons to be worried about the sector's production performance include the country's excessive use of imported rice and wheat.

Limited use of modern equipment, low productivity, and subsistence farming characterise the sector, despite efforts to improve it. As a result, farmers' income is low and their output is low. A lot of the country's agricultural product export potential is still unrealised. Some promising trends in agriculture, including rising interest in agribusiness and higher rice output, are still in their early stages and have not yet resulted in a systemic shift in the industry as a whole. Concerns regarding the effect of bank sector loans on the sector's production have been heightened by the fact that the sector's overall performance has lagged behind forecasts for decades. There is research in the literature that are pertinent. But much of the research looked at how government spending affected the growth of the agriculture industry. Several other studies in Nigeria have looked at how bank loans affect agricultural production (e.g., Abu, 2024; Aginam, 2024; Yusuf, Yusuf, Oladipo, Gajere, and Ojih, 2024; Magaji, Usman, and Yusuf, 2023; Onuegbu, Ikeora, and Promise, 2022; Golley and Samuel, 2021). Not only was the entire agriculture industry considered in this study, but so were other subsectors. In light of the importance of subsectors like crops and animals, this study adds to the current literature by analysing the effect of bank loans on agricultural output.

Study Objectives

The study's overarching goal is to look at how bank sector credit affects agricultural production in Nigeria. Specifically, we want to do the following:

i. Analyse how grain production in Nigeria has changed as a result of loans and advances made by deposit money institutions.
ii. To learn how the livestock subsector in Nigeria's economy has been affected by advances and loans from deposit money banks.
iii. Determine how much of an impact deposit money banks have on Nigerian farmers' output.

Conceptual Framework

Credit in the Banking Sector

Lenders extend credit when they lend money to borrowers. A credit agreement states that the borrower will pay the lender back for the goods and services they have received. A loan is a quantity of money that has a future payback deadline. Since banks facilitate the flow of deposits from economic surplus units to deficit units in need of funds for productive purposes, it is impossible to disentangle credit from the banking sector (Aremu, Suberu and Oke, 2016).

Bank sector credit is defined by Ngong, Onyejiaku, Fonchamnyo, and Onwumere (2023) as loans given by financial institutions for investments in agriculture. Bank sector credit is defined by Jude and Onyekachi (2018) as the ability of the banking system to lend money to individuals, businesses, governments, and other entities. The term "bank sector credit" describes the sum total of loans and advances made by financial institutions to different participants in the economy. Not only did Magaji, Usman, and Yusuf (2023) share this view, but so did Ayuba, Magaji, and Kuna (2013). Supplier trade credit, invoice discounting, bill financing, hire purchase, factoring, overdraft, advances, loans, and commercial papers (or note) were some of the terms they used to express the idea. For the sake of this analysis, "bank sector credit" refers to loans extended by financial institutions to ranch operations for the purpose of growing and harvesting crops and funding the feeding and care of cattle. The project's objective and gestation period determine the type of bank sector funding, which can be overdraft, short-term, medium-term, or long-term.

Produced by Farmers

Idoko, Sunday, and Sheri (2012) state that agriculture is the process of cultivating plants and animals in a controlled setting to produce goods such as food, feed, fibre, and more. According to them, it's all about maintaining land so that people and other creatures can eat. Agriculture refers to the practice of intentionally or deliberately working with plants and animals to produce food or raise livestock (Georgina, 2024). Humans engage in agriculture when they cultivate land and raise animals for human consumption, animal feed, and industrial raw resources. Activities such as fishing, forestry, processing, and selling agricultural goods are all part of this. Akinboyo (2018) states that the main components of this sector include farming, raising cattle, forestry, and fishing. The use of land for the cultivation of plants and animals is defined by Anayo (2017) as agriculture. It entails refocusing resources on human agriculture and animal consumption while simultaneously de-complicating natural food webs. Agriculture was described by Egwu (2016) as the human effort to cultivate land and its inhabitants in harmony with natural processes in order to increase food production. Fishing, cattle ranching, poultry, and forestry are all encompassed in it.

The authors Akintunde, Adesope, and Okoruwa (2013) defined agricultural output as the increase in economic output that occurs when farmers use new input materials and production tactics. Agricultural output is defined similarly by the OECD (2024): it is the total quantity of output sold, including items traded between agricultural holdings, changes in stockpiles, products made for final consumption, products made for additional processing, and livestock feed products consumed intra-unit. All of the following factors contribute to agricultural output after adjustments: output from previous years' crops, total livestock enterprise output, output from home grown fodder crops, output from tillages and forage, revenue from nonagricultural diversified activities, and miscellaneous items. This study, similar to the one conducted by Idoko, Sunday, and Sheri (2012), looked at the output of agriculture. Food, feed, fibre, and other agricultural products are created via the methodical raising and gathering of plants and animals. There are several ways to break down agricultural output, such as by animals and crops.

The crop subsector output is the sum of all agricultural crops produced by a country or region during a certain time period; this is typically measured every year. Grown for human consumption, commercial sale, or processing, this output encompasses a vast array of crops, from food crops (such as cereals, vegetables, and fruits) to cash crops (such as coffee, cotton, and tobacco). Criteria for Crop Subsector Production Food Crops: Commonly grown crops for human consumption or trade, including wheat, rice, maize, potatoes, and vegetables. Coffee, cocoa, sugarcane, and cotton are examples of cash crops, which are plants mostly cultivated for the purpose of export or commercial sale. Industrial crops include things like oilseeds, rubber, and jute. According to Cherlinka (2024) and the US Environmental Protection Agency (2024), horticultural products, which include edible fruits, nuts, and vegetables, typically fetch a premium price at market.

What we call "livestock subsector output" is really just the sum of all the products and services produced by the livestock subsector in a specific time frame, often a year. Meat, dairy, eggs, wool, hides, and any other agricultural economy-beneficial byproducts are all part of this output. Animal Production: The results of raising animals for their meat, including pigs, goats, sheep, and cattle. Milk and other dairy products derived from animals such as goats and cows are produced in the dairy industry. When chickens, especially hens, lay eggs, this process is called egg production. Cattle byproducts include items that are not consumed by humans, such as fur, hides, and excrement (which is usually utilised as a fertiliser) (Cherlinka, 2024). It is common practice to adjust the quantitative or monetary measures of production for inflation when comparing actual growth over time. Common units of measurement include metric tonnes, bushels, and currency units. For lawmakers to monitor agricultural output, distribute funds, and assess the necessity of agricultural support programs, this data is vital. Economists and politicians seeking to improve food security, rural development, and sustainable agriculture practices should pay close attention to the livestock subsector's production (Cherlinka, 2024; US Environmental Protection Agency, 2024).

Theoretical Literature

Production Function via Cobb-Douglas

Cobb-Douglas theory of production functions is the theoretical basis of the study. In 1928, it was created with the assistance of economist Paul Douglas and mathematician Charles Cobb. Major components in the increase of production, according to the theory, include changes in the amount of labour and capital and breakthroughs in technology. In theory, for output to rise, three conditions must be satisfied. In order to make this work for the research, we employ the Cobb-Douglas production function. According to Castejón and Woerz (2005), the Cobb-Douglas production function specifies the following at time t, with constant returns to scale:

$$Y(t) = A(t)\, K(t)^{\alpha} L(t)^{1-\alpha}, \quad 0 < \alpha > \qquad (1)\backslash$$

Where;

α = a share of capital in total output

1-α = a share of output paid to labour.

Keep in mind that capital expands exogenously at n times the rate of population growth (n) and technology grows at a rate of g times the rate of labour productivity (g) when you evaluate these two variables. Savings and investment (s) are assumed to represent a constant percentage of total production. This leads to the following formula for the stock of capital as a percentage of labour:

$$K = \frac{K}{AL} \qquad (2)$$

However, the following is the level of production for every effective worker:

$$y = \frac{Y}{AL} \qquad (3)$$

This demonstrates that capital accumulation is the primary driver of economic growth. Total income will shift in response to changes in capital. The rate of increase of capital stock, denoted as dK/dt or˘, is the net investment, which is calculated using the following equation:

$$\underline{K} = sf(K) - (n + g + \delta)K = sK^{\alpha} - (n + g + \delta)K \quad . \quad . \quad (4)$$

Where sf(K) represents a percentage of the money that was saved and, consequently, invested. Capital growth is favourably correlated with investment levels and negatively correlated with depreciation rate (δ), population growth rate (n), and rate of technical progress (g), according to Equation (3.3) (Koutun and Karabona, 2013; and Solow, 1956).

Sustainable Livelihood Theory

Ubah (2008) cites Chambers and Conway (1991) as saying that "the capabilities, assets (including both capital and social resources) and other farming practices required for a means of living" constitute a sustainable lifestyle. Access to financial resources and income-earning activities, including reserves and assets to offset risk and relieve shocks over a lengthy period, are the only guarantees that can lead to greater output (or food security), according to the theory. Boosting agricultural production (food security) goes beyond just making food more affordable, claims Ubah (2008). The capacity to cultivate food and get a steady income from farmers is a part of it. The importance of credit and financial resources in guaranteeing an increase in agricultural output was highlighted by this theory, as it was by the structural change hypothesis discussed before.

The New Environmental Modernists

In collaboration with the Global 2000 Foundations, Sasakawa created this. They claim that high external input farming, either on Green Revolution lands already in existence or on the "high potential" places neglected during previous agricultural development, can boost agricultural output. They made the point that creditors/funds, synthetic fertilisers, herbicides, high-yielding seed varieties, and other outside inputs for farmers are necessary for increased agricultural production. Government spending on fertilisers, insecticides, high-yielding seed, and farmers' credits/funds is the main way for a country to boost agricultural production. They went on to say that high-input agriculture is better for the environment than low-input agriculture. This is due to the fact that minimal input agriculture often leads to the degradation of local resources due to their heavy use. To summarise, the theory posits that the amount of agricultural output and macroeconomic development are strongly influenced by the availability of credit to farmers, particularly small holder farmers (Ubah, 2008).

Empirical Literature

Abu (2024) investigated how loans from commercial banks affected agricultural production in Nigeria. All of the years from 1992 to 2021 were considered in the study. In order to analyse the data, ordinary least squares (OLS) was employed. The research found that private bank loans and government grants greatly boosted agricultural output growth.

The impact of bank loans on agricultural output in Nigeria was examined by Aginam (2024). The research was conducted from 1981 to 2022 inclusive. In our search for trends, we employed correlation and least squares regression analyses. The value of loans insured by the ACGSF has a beneficial impact on agricultural productivity, according to research. The study found that the repayment compliance rate of ACGSF was positively correlated with agricultural sector output. It was also established that bank loans and advances did little to increase agricultural output.

Based on data collected between 1990 and 2022, Yusuf, Yusuf, Oladipo, Gajere, and Ojih (2024) assessed the impact of loans made by deposit money banks in Nigeria to the agricultural sector. This research made use of the multiple regression technique to analyse the collected data. Funds from the agricultural credit guarantee scheme (ACGS) and loans from commercial banks to the agricultural sector (CBCA) had a positive and strongly significant impact on sector performance.

The impact of commercial bank loans on crop yields in Nigeria was investigated by Magaji, Usman, and Yusuf (2023). Researchers in Abuja, Nigeria's Federal Capital Territory, analysed information gathered directly from commercial banks and borrowers who were looking for loans for agriculture. Several descriptive statistics were employed to analyse the data, including logistic regression, standard deviation, and mean. The research found that crop yields were boosted by agricultural loans from commercial banks.

Using data collected from 1990 to 2019, Ngong, Onyejiaku, Fonchamnyo, and Onwumere (2023) analysed the impact of bank lending on agricultural output in CEMAC nations. The study utilised autoregressive distributed lag as its methodology. The findings revealed that local bank loans to the private sector, land, and physical capita all had a favourable effect on agriculture value added. Broad money supply, inflation, and labour all had a detrimental impact on the value of agriculture's contribution to GDP.

Rodríguez and Chávez (2023) examined the impact of commercial bank loans on economic activity across Mexico's industrial sector and seven particular industries, including food, beverage, and tobacco. Data sets utilised in the study were updated monthly from July 2009 to March 2020. Here is the data The ARDL bounds test method was used to evaluate the results. The analysis shows that bank lending has a positive and statistically significant impact on production across the board and in specific industries like food, drink, and tobacco.

The impact of commercial bank loans on agricultural production in Nigeria was examined by Onuegbu, Ikeora, and Promise (2022) from 1980 to 2013. The data was analysed using Ordinary Least Squares (OLS). While interest rates had a negative but statistically insignificant impact on agricultural production, bank lending, government expenditure on the agricultural sector, and the Agricultural lending Guarantee Scheme Fund all had positive and statistically significant relationships with agricultural production.

Commercial bank loans had an impact on Nigeria's agricultural sector, which Golley and Samuel (2021) looked at. All study was conducted within the years 1993–2019. In order to analyse the data, the OLS method was employed. The study found that commercial bank lending led to improved loan evaluation and food security in Nigeria. Using the Indicator Saturation (IS) break test, ARDL limits test, and Toda Yamamoto Granger causality test, researchers Anh, Gan, and Anh (2020) investigated the effect of credit on agricultural output in Vietnam from 2004Q4 to 2016Q4. Research showed that agricultural financing greatly improved crop yields over the course of the study's time frame. There is a positive and a negative correlation between agricultural lending and agricultural production.

Using data collected in Turkey from 1998 to 2016, Bahsi and Cetin (2020) examined the impact of agricultural financing on the value of agricultural production using the Ordinary Least Squares (OLS) method. The findings indicate that agricultural financing greatly enhances agricultural production. Florence and Nathan (2020) use the Autoregressive Distributed Lag Model to examine the effect of commercial bank lending on agricultural growth in Uganda from 2008Q3 to 2018Q4. Although there was no immediate effect of bank lending on agricultural output, there was a substantial long-term effect. The impact of commercial bank lending on the expansion of Nigeria's agricultural industry was examined by Ita, Owui, Dunsin, and Ita (2020) from 1986 to 2019. We used the multiple regression method to analyse the data statistically. It was found that agricultural output was significantly affected by bank assets, interest rates, liquidity, and loans and advances.

Commercial bank loans in Nigeria affected agricultural development between 1981 and 2018, according to Okafor (2020), who used an OLS framework to analyse the data. Bank lending to agriculture and ACGSF had a beneficial effect on agricultural productivity, according to the data.

Orji, Ogbuabor, Anthony-Orji, and Alisigwe (2020) used the Pairwise Granger causality test to look at the 1981–2018 relationship between agricultural funding and agricultural output in Nigeria.

The results showed that more money going into agriculture does not lead to more harvests. Medugu, Musa, and Abalis (2019) used data from 1980 to 2016 to analyse how commercial bank loans affected agricultural output in Nigeria. The OLS method was utilised in this study. Government investment on agriculture and loans given by commercial banks both had a favourable and considerable effect on agricultural production, according to the results.

The impact of loans from commercial banks on agricultural production in Nigeria was examined by Oyelade (2019) from 1980 to 2015. The study employed both Ordinary Least Squares (OLS) and Fully Modified Ordinary Least Squares (FMOLS). The study's findings demonstrated that commercial bank interest rates on agricultural loans and deposit money bank assets had a substantial impact on Nigeria's agricultural output during the study period. Other assets discovered included commercial bank loans to the agriculture sector and deposit money bank assets.

The impact of commercial bank loans on the expansion of agricultural investment in Kurdistan was examined by Bilbas (2018) over the period of 1980 to 2017. The OLS method was utilised in this study. George-Anokwuru (2018) examined the impact of deposit money bank loans on agricultural production in Nigeria from 1985 to 2015 and found that these loans had a positive and statistically significant effect on agricultural development. In order to analyse the data, the OLS method was employed. The study found that agricultural productivity was positively and significantly impacted by credit from deposit money institutions. Additionally, it was found that interest rates had a negative, but statistically negligible, impact on agricultural sector output. The findings also showed that there was a positive and substantial relationship between the money supply and agricultural output. Using a vector autoregressive model, Hassan (2017) evaluated the effect of Pakistan's financial sector expansion on agricultural growth. Including the years 1981–2015. In order to analyse the data, the OLS method was employed. Capital, bank credit, and liquid liabilities are all important factors in increasing agricultural production, according to research.

Ogbuabor and Nwosu (2017) used an error correction model to examine the impact of deposit money bank agricultural loans on agricultural productivity in Nigeria from 1981 to 2014. While the short-term impact of agricultural loans from deposit money institutions was negligible, the long-term effects were positive and large. Agricultural land and labour force had negative effects on agricultural output in the long and short term, although annual rainfall and average temperature, two climate change factors, were shown to have no influence.

Value Addition

In the available literature, you can locate pertinent studies. However, most studies focused on how government spending correlates with agricultural sector improvement. A number of studies have examined the correlation between bank loans and agricultural production in Nigeria; however, all of these studies have concentrated on total agricultural production rather than individual farms or regions. These include Abu (2024), Aginam (2024), Magaji, Usman and Yusuf (2023), Onuegbu, Ikeora and Promise (2022), and Golley and Samuel (2021). This study considered the entire agriculture industry as well as other subsectors. Therefore, this research adds to the existing body of knowledge by investigating the relationship between bank sector loans and agricultural production, with a focus on important subsectors such as crops and animals.

Methodology

This investigation made use of the longitudinal research strategy. This is due to the fact that the study is a time series. Time series data is utilised in this study. Included are loan and advance amounts from deposit money institutions to the agricultural sector, average annual rainfall, consumer price index, and agricultural productivity. A yearly frequency structure and chronological organisation characterise the data set used in the investigation.

Data Source
The data used in this study was sourced from the Statistical Bulletin of the Central Bank of Nigeria. The publication contains information for all the model variables and covers a wide range of issues. The source datasets are yearly time series covering the sample periods from 1981 to 2023.

Model Specification
Researching the effects of deposit money institutions' loans and advances on the agriculture production subsector is the main objective. The functional model for the first objective is as follows:

$$CROUTPUT = LOAN, CPI, \text{RAIN}, POPG \quad (1)$$

Where;
CROUTPUT = crops subsector output
LOAN = deposit money banks' loans and advances to agriculture
CPI = consumer price index
RAIN = annual rain falls
POPG = population growth

After taking the log of the variables, equation (1) is re-specified in autoregressive distributed lag (ARDL) form as follows:

$$logCROUTPUT = \alpha_0 + \alpha_1 logCROUTPUT_{t-1} + \alpha_2 logLOAN + \alpha_3 CPI + \alpha_4 log\text{RAIN} + \alpha_5 POPG + \sum_{j=k}^{p} \vartheta_1 logCROUTPUT_{t-j} + \sum_{s=k}^{q} \vartheta_2 logLOAN_{t-s} + \sum_{m=k}^{q} \vartheta_3 CPI_{t-m} + \sum_{z=k}^{q} \vartheta_4 logRAIN_{t-z} + \sum_{z=k}^{q} \vartheta_5 POPG_{t-z} + \mu_{1t} \quad (2)$$

The various elements in equation (2) stand for variables with a short time horizon, whilst the lag terms denote variables with a lengthy time horizon. Since CPI and POPG are already variables in rates, they are not logged. The error term is represented by 〖 μ〗_1t,〖 and the long-run parameters of the variables are 〖 a〗 _i (i = 1,2,3, …5), while the short-run parameters are 〖 ϑ〗 _i (i = 1,2,3, …5). The Akaike information lag length selection method should be used to find the appropriate lag length.

The small sample size is a major benefit of this method. Additionally, this model includes endogenous regressors and gives unbiased estimates and t-values for both short-run and long-run periods. If the regressors are stationary at I(0), I(1), or both, then the model can be utilised. We can represent the variables' adaptation to equilibrium using an error correction model, which is defined as follows, if we find that the variables are cointegrated.

$$\Delta logCROUTPUT = \vartheta_0 + \sum_{j=k}^{p} \vartheta_1 logCROUTPUT_{t-j} + \sum_{s=k}^{q} \vartheta_2 logLOAN_{t-s} + \sum_{m=k}^{q} \vartheta_3 CPI_{t-m} + \sum_{z=k}^{q} \vartheta_4 logRAIN_{t-z} + \sum_{z=k}^{q} \vartheta_5 POPG_{t-z} + ECM_{t-1} + \mu_{1t} \quad (3)$$

Where $ECM1_{t-1}$ is the error correction term?

The following functional form is defined to encapsulate aim two, which is to evaluate the influence of credit and advances from deposit money institutions on livestock subsector production; The following functional form is defined to encapsulate aim two, which is to evaluate the influence of credit and advances from deposit money institutions on livestock subsector production;

$$LSOUTPUT = LOAN, CPI, \text{RAIN}, POPG \quad (4)$$

Where;
LSOUTPUT = livestock subsector output
LOAN = deposit money banks' loans and advances to agriculture
CPI = consumer price index
RAIN = annual rain falls
POPG = population growth

Here is the re-specification of equation (4) in autoregressive distributed lag (ARDL) form after obtaining the log of the variables:

$$logLSOUTPUT = b_0 + b_1 logLSOUTPUT_{t-1} + b_2 logLOAN + b_3 CPI + b_4 log\text{RAIN} + b_5 POPG + \sum_{j=K}^{p} \beta_1 logLSOUTPUT_{t-j} + \sum_{s=K}^{q} \beta_2 logLOAN_{t-s} + \sum_{m=K}^{q} \beta_3 CPI_{t-m} + \sum_{z=K}^{q} \beta_4 logRAIN_{t-z} + \sum_{z=K}^{q} \beta_5 POPG_{t-z} + \mu_{2t} \quad (5)$$

The various elements in equation (5) stand for variables with a short time horizon, whilst the lag terms denote variables with a lengthy time horizon. The variables CPI and POPG are not recorded because they are already in the rates. The error term is denoted as Ↄ_1t, and the long-run and short-run parameters of the variables are b_i (i = 1,2,3, …5) and γ_i (i = 1,2,3, …5, respectively). The Akaike information lag length selection method should be used to find the appropriate lag length.

$$\Delta logLSOUTPUT = a_0 + \sum_{j=K}^{p} \beta_1 logLSOUTPUT_{t-j} + \sum_{s=K}^{q} \beta_2 logLOAN_{t-s} + \sum_{m=K}^{q} \beta_3 CPI_{t-m} + \sum_{z=K}^{q} \beta_4 logRAIN_{t-z} + \sum_{z=K}^{q} \beta_5 POPG_{t-z} + ECM_{t-2} + \mu_{2t} \quad (6)$$

Where $ECM1_{t-2}$ is the error correction term

With respect to the third aim, which is to ascertain the effect on Nigeria's total agricultural production of the loans and advances made available by deposit money institutions, the following functional form is defined;

$$AGOUTPUT = LOAN, CPI, \text{RAIN}, GKEXP \quad (7)$$

Where;
AGOUTPUT = Aggregate agricultural output
LOAN = deposit money banks' loans and advances to agriculture
CPI = consumer price index
RAIN = annual rain falls
GKEXP = government capital expenditure

After taking the log of the variables, equation (7) is re-specified in autoregressive distributed lag (ARDL) form as follows:

$$logAGOUTPUT = \varphi_0 + \varphi_1 logAGOUTPUT_{t-1} + \varphi_2 logLOAN + \varphi_3 CPI + \varphi_4 log\text{RAIN} + \varphi_5 GKEXP + \sum_{j=k}^{p} \gamma_1 logAGOUTPUT_{t-j} + \sum_{s=k}^{q} \gamma_2 logLOAN_{t-s} + \sum_{m=k}^{q} \gamma_3 CPI_{t-m} + \sum_{z=k}^{q} \gamma_4 logRAIN_{t-z} + \sum_{z=k}^{q} \gamma_5 GKEXP_{t-z} + \mu_{3t} \quad (8)$$

The various elements in equation (8) stand for variables with a short time horizon, whilst the lag terms denote variables with a lengthy time horizon. Since CPI is already a rate variable, it is not logged. The long-run and short-run parameters of the variables are represented by 〖 and γ〗 _i (i = 1,2,3, …5), respectively, whereas 〖 μ〗 _3t is the error term. The Akaike information lag length selection method should be used to find the appropriate lag length.

$$\Delta logAGOUTPUT = a_0 + \sum_{j=k}^{p} \gamma_1 logAGOUTPUT_{t-j} + \sum_{s=k}^{q} \gamma_2 logLOAN_{t-s} + \sum_{m=k}^{q} \gamma_3 CPI_{t-m} + \sum_{z=k}^{q} \gamma_4 logRAIN_{t-z} + \sum_{z=k}^{q} \gamma_5 GKEXP_{t-z} + ECM_{t-3} + \mu_{1t} \quad (9)$$

Where $ECM1_{t-3}$ is the error correction term?

Definition of the Variables in the Model
Here we define the variables used in the models.
This is the entire amount or value of agricultural crops produced throughout a certain period, usually measured annually, by Nigeria. It is called crops subsector output (CROUTPUT). Total value or quantity of agricultural livestock produced over a certain period, usually assessed annually, is known as livestock subsector output (LSOUTPUT) in Nigeria. The term "deposit money banks' loans and advances to agriculture" (LOAN) describes the sum of all the money that commercial banks lend to those working in agriculture. Crop cultivation, animal farming, aquaculture, and agribusiness operations are some of the agricultural industries that can benefit from these loans, which aim to boost productivity.

The term "population growth" (POPG) refers to the increase in a population's numerical value over a given time frame. Because it considers things like births, deaths, immigration, and emigration, it shows how a population grows or shrinks. A yearly percentage is a common way to quantify population growth.

Results and Discussion

Descriptive Statistics of the Variables

The variables' features, such as their mean and skewness, were investigated using descriptive statistics. On Table 1, you can see the projected outcomes of these descriptive statistics.The variables' features, such as their mean and skewness, were investigated using descriptive statistics. On Table 1, you can see the projected outcomes of these descriptive statistics.

Table 1: Descriptive Statistics

Variables	Obs.	Mean	Standard Deviation	Minimum value	Maximum value	P-value (Skewness)	P-value (Kurtosis)
CROUTPUT	43	7933.718	5545.458	1759.115	17585.43	0.2196	0.0000
LSOUTPUT	43	732.5561	313.3298	341.4115	1247.719	0.1758	0.0000
AGOUTPUT	43	8972.015	6016.322	2303.505	19306.49	0.2127	0.0000
LAON	43	278.236	502.4696	0.0940	2255.357	0.0000	0.0002
CPI	43	129.774	143.9659	1.0279	643.7812	0.0001	0.0057
RAIN	43	193.9581	170.6269	3.1	551.2	0.0396	0.1863
POPG	43	2.6231	0.2244	2.0928	3.0749	0.0059	0.1295
GKEXP	43	703.3185	938.7777	4.1001	4486.206	0.0000	0.0003

Source: Estimated by the researcher

There was little change from the starting point for either the consumer price index (1297.77%) or the population growth rate (2.62%), which both remained relatively constant throughout the study period. Concurrently, ₦7,933.718 billion was the average output for the crop's subsector, ₦732.5561 billion for the livestock subsector, and ₦8,972.015 billion for the total agricultural output. In addition, there was an average of 193.9581 mm of rainfall per year, 703.3185 billion in government capital investment, and ₦278.236 billion in loans and advances to agricultural from deposit money institutions. Throughout the research period, these figures represent the average impact of every variable.

The standard deviations of the following variables are fairly close to their means: 313.3298, 502.4696, 143.9659, 170.6269, yearly rainfall, government capital expenditure, population growth, and deposit money banks' loans and advances to agriculture. These variables also show moderate variability. It may be inferred from this that these variables maintained relatively constant values throughout the research period. Standard deviations of 5,545.458 and 6,016.322, respectively, indicate high variability in the crop's subsector output and aggregate agricultural output. These outliers, when compared to the means, show that there were huge swings and a more dispersed distribution of the variables in the sample.

During the research period, the population growth rate was 2.0928% and the consumer price index reached a low of 1.0279 percent. The lowest values for the following categories were ₦1,759.115 billion, ₦341.4115 billion, ₦2,303.505 billion, ₦0.0940 billion, 3.1 millimetres (mm), and ₦4.1001 billion, respectively: aggregate agricultural output, annual rainfall, government capital expenditure, loans and advances to agriculture from deposit money banks, subsector output for crops, subsector output for livestock, and individual subsectors. In contrast, both the CPI and the population growth rate peaked at 643.7812% and 3.0749%, respectively. There were peak values of 1,247.719 billion, 19,306.49 billion, 2,255.357 billion, 551.2 millimetres (mm), and 4,486.206 billion for the following categories: aggregate agricultural output, annual rainfall, output from the crop's subsector, and output from the livestock subsector, respectively. All variables have maximum values lower than their means and lowest values greater than zero, giving the impression that the data is symmetrically distributed about the mean. This provides more evidence that there are no outliers in the dataset used for the study.

Annual rainfall, population growth, government capital spending, the consumer price index, and the probability values for loans and advances to agricultural from deposit money institutions were all determined to be skewness-related variables at the 5% level of significance. We reject the null hypothesis of normal distribution since the results demonstrate that the distributions of these variables are not symmetrical and are skewed, either positively or negatively. We were unable to reject the normality hypothesis since there were no significant probability values at the 5% level for the aggregate agricultural output, the crops subsector output, and the livestock subsector production. Consequently, we put these variables' normal distributions to the test.

At the 5% level of significance, the following kurtosis-related variables were identified: aggregate agricultural output, consumer price index, loans and advances to agriculture from deposit money institutions, government capital spending, and output by the crop's subsector. The density or lack thereof of tails in the distributions of these variables leads us to conclude that they do not follow a normal distribution, and we thus reject the null hypothesis of normal kurtosis. According to these results, the normal distribution of these variables is false. The normal kurtosis null hypothesis could not be rejected since the yearly rainfall and population growth kurtosis probability values were not statistically significant at the 5% level. Both variables exhibit characteristics of a normally distributed set, according to the findings.

Lag Order Selection

In order to find the best lag length, the Akaike Information Criterion (AIC) was used. The results showed that a two-second lag was the best and most statistically significant, as shown in Table 2. Consequently, the best structure for the models used in this investigation was a lag duration of two.

Table 2: Lag Order

Lag	LL	LR	df.	P	AIC	HQIC	SBIC
0	-1775.08				86.9797	87.1014	87.314
1	-1464.46	621.24	64	0.000	74.9493	76.0451*	77.9585*
2	-1398.14	132.64*	64	0.000	74.8362*	76.906	80.5203

Source: Estimated by the researcher

Unit Root Test

To ensure that the time series variables used in the models were stationary, we utilised the Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. The results of the tests are shown in Table 3.

Table 3: Augmented Dickey-Fuller and Philips–Perron unit root test results

Variable	Augmented Dickey-Fuller Result		Philips–Perron Result		Lag order	Order of Integration
	Level	1st Difference	Level	1st Difference	Lag	Order of Integration
logCROUTPUT	-1.301	-3.694	-1.717	-6.092	2	I(1)
logLSOUTPUT	-1.651	-3.746	-0.932	-4.876	2	I(1)
logAGOUTPUT	-1.326	-3.408	-1.645	-6.017	2	I(1)
logLAON	-5.104	-	-4.019	-	2	I(0)
logRAIN	-3.767	-	-6.181	-	2	I(0)
logGKEXP	-1.681	-3.801	-1.619	-6.865	2	I(1)
CPI	-2.441	-4.291	-2.792	-6.702	2	I(1)
POPG	-0.424	-4.190	-1.508	-5.252	2	I(1)

At the 5% level of significance, the symbol * denotes the rejection of the null hypothesis that there is no unit root. A lag length of 2 was shown to be optimal using Akaike's Information Criteria (AIC). The levels have a critical value of -3.540, however the ADF 5% value for the first difference is -3.544. The Philips-Perron critical values are -3.532 at levels and -3.536 at the first difference. Augmented Dickey -Fuller and Philips -Perron both used a trend in their unit root test models.

Source: Estimated by the researcher

All variables' test statistics, as per the Augmented Dickey-Fuller (ADF) test results, are below the 5% critical values at level, with the exception of annual rainfall and loans and advances to agriculture. With the exception of these two variables, none of the others are statistically significant at the 5% level; thus, the null hypothesis of a unit root cannot be rejected. With the exception of annual rainfall and loans and advances to agricultural from deposit money institutions, all of the other variables are non-stationary in their level form. A one-time difference for the non-stationary variables and subsequent repetition of the stationarity tests enabled this to be corrected. We may reject the unit root hypothesis because the test statistics exceeded the 5% critical values after the first differencing, showing that the variables have become stationary. According to the Phillips-Perron (PP) test, which validated the ADF results, the variables became stationary after first differencing, even if they were initially non-stationary (except from yearly rainfall and loans and advances to agricultural from deposit money banks).

The Effect of Crops Subsector Output on Loans and Advances from Deposit Money Banks to Agriculture

To assess how deposit money institutions' loans and advances affected crop subsector output, the first objective-addressing model was calculated. To begin, we ran the Bounds test, which looks for cointegration—a level relationship—among the objective one model variables. Table 4 displays the results of the test.

Table 4: Bounds test result for the variables in the model for objective one

	10%		5%		1%		p-value	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
F	2.585	3.949	3.153	4.715	4.525	6.551	0.000	0.000
t	-2.474	-3.589	-2.843	-4.020	-3.595	-4.898	0.000	0.000
F = 6.829 t = -5.732								

Source: Author's computation

Using a significance threshold of 5%, the computed F-statistic of 6.829 exceeds both the lower and upper critical bounds. By rejecting the null hypothesis of no level link, cointegration among the variables is proven when it surpasses the upper bound. At the 5% level of significance, the absolute value of the t-statistic (-5.732) is greater than the lower and upper critical t-values, providing more evidence of cointegration. Their p-values are statistically significant, which further proves that the level (order 0) and first-differenced (order 1) variables do not support the null hypothesis. Table 5 details the findings, which validate the cointegration and provide the groundwork for estimating the ECM.

Table 5: Error Correction Estimates of the ARDL model for objective one

Crops subsector output is the dependent variable. (CROUTPUT)				
logCROUTPUT	coefficients	Standard Errors	t-Statistics	P-value
Adjustment	-0.0671	0.0245	-2.73	0.008
Long-Run				
logLAON	0.3835	0. 1102	3.48	0.000
CPI	0. 1012	0. 0446	2.27	0.044
logRAIN	-0.3111	0.5083	-0.61	0.546
POPG	3.1049	1.0525	2.95	0.001
Short-Run				
$logCROUTPUT_{t-1}$	0.0394	0.1954	0.20	0.842
logLAON	0.0533	0.0489	1.09	0.719
CPI	0.1303	0.0515	2.53	0.019
logRAIN	0.0388	0.0134	2.91	0.007
POPG	0.1753	0.2814	0.62	0.539
Constant	0.0741	0.5095	0.15	0.885
R-squared			0.5426	
Adjusted R-Squared			0.2964	
Durbin–Watson d-statistic (15, 41)		1.9646		
Breusch–Pagan/Cook – Weisberg test for heteroskedasticity			0.104 (p = 0.7470)	

Source: Author's computation

Both the t-value and the error correction adjustment coefficient were -2.73 and -0.0671, respectively, in the results. In the event of short-run disequilibrium, the model's variables rebalance themselves towards long-run equilibrium at a rate of 6.71 percent per annum, as demonstrated by the statistically significant negative coefficient. Based on this, the system would need more than fifteen years to fully recuperate from any economic shocks that disrupt equilibrium. With a t-value of 3.48, the computed long-run coefficient for agricultural loans and advances from deposit money institutions was 0.3835. Loans and advances to agriculture from deposit money institutions do have an impact on crop subsector output, since the t-value is statistically significant at the 5% level. Therefore, we may reject the null hypothesis. More specifically, for every one percent increase in agricultural advances and credits, the numbers reveal that the crop subsector's production rises by 0.38 percent over time. The correlation was positive but not statistically significant in the short run, with a t-value of 1.09 and a coefficient of 0.0533. A 1% rise in loans and advances to agricultural from deposit money institutions is accompanied by a little and insignificant 0.05 percent increase in crops subsector output in the short run. Therefore, crop subsector output was positively and statistically significantly affected by loans and advances from deposit money institutions over the long term, but only positively and without statistical significance in the short term.

Over the long term, the consumer price index showed a t-value of 2.27 and a coefficient of 0.1012. At the 5% level of significance, the t-value proves that the CPI has a significant impact on the output of Nigeria's agricultural subsector, thereby rejecting the null hypothesis. One interesting finding is that for every one percent increase in the consumer price index, the crops subsector's output rises by 0.10%. At the 5% level of significance, the consumer price index also demonstrated a positive short-term coefficient of 0.1303 with a t-value of 2.53. This research shows that for every one percent increase in the CPI, agricultural output increases by a statistically significant 0.13 percent. Consequently, the results demonstrate that the consumer price index had a substantial and beneficial effect on agricultural output within the crops subsector, both in the short and long term.

With a t-value of -0.61 and a long-term predicted coefficient for yearly rainfall of -0.3111, we may conclude that there is no statistical significance at the 5% level. Therefore, we adopt the null hypothesis, which states that the crops subsector of Nigeria's agricultural output is unaffected by annual rainfall. In instance, the numbers show that the crops subsector's production drops by 0.31% when annual rainfall increases, which is a modest but long-term association. In contrast, a t-value of 2.91 and a short-run coefficient of 0.0388 for annual rainfall were significant at the 5% level of analysis. For the time being, this finding contradicts the null hypothesis and implies that annual rainfall significantly affects crop production in the agriculture subsector. Thus, annual rainfall had a small but negative impact on agricultural subsector output in the long run, but a large and favourable effect in the near run.

The long-run coefficient for population growth is 3.1049, while the t-value is 2.95. The t-value is statistically significant at the 5% level of significance, rejecting the null hypothesis that the crops subsector's agricultural output is unaffected by population increase. A direct consequence of the acceleration in population growth was a significant 3.10 percent increase in the output of the crop's subsector. However, in the near run, the result was favourable but not statistically significant (t=0.62, coefficient=0.1753). A plausible interpretation is that the crops subsector's output increased by a tiny but positive 0.18 percent as a result of the population boom. Consequently, population growth had a favourable and substantial impact on crops subsector agricultural output in the long run, but a much smaller one in the short run.

A coefficient of determination (R^2) of 0.5426 indicates that the independent variables account for approximately 54.26% of the long- and short-term variation in agricultural output in the crop's subsector. The remaining variation is explained by other factors that were not taken into consideration when developing the model. The Durbin-Watson test for autocorrelation yielded a value of 1.9646. Since this value is so close to 2, we can confidently accept the null hypothesis that no autocorrelation exists. To rule out heteroskedasticity, the Breusch-Pagan/Cook-Weisberg test yielded a coefficient of 0.104 and a p-value of 0.7470. Because the p-value is not statistically significant at the 5% level, we can conclude that the variables have constant variance, which supports the null hypothesis of homoskedasticity.

Impact of Loans and Advances from Deposit Money Banks to Agriculture on Livestock Subsector Output

The impact of agricultural loans and advances from deposit money banks on livestock subsector agricultural output was the focus of the second objective-related model. Bounds testing, which seeks to determine whether the variables in the second objective model have a level relationship (cointegration), was the first step in the investigation. The results of the test are shown in Table 6.

Table 6: Bounds test result for the variables in the model for objective two

	10%		5%		1%		p-value	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
F	2.585	3.949	3.153	4.715	4.525	6.551	0.000	0.000
t	-2.474	-3.589	-2.843	-4.020	-3.595	-4.898	0.000	0.000
F = 7.257 t = -7.059								

Source: Author's computation

Because it is bigger than the left and right critical borders, the estimated F-statistic of 7.257 is significant at the 5% level. By rejecting the null hypothesis of no level link, cointegration among the variables is proven when it surpasses the upper bound. The fact that the absolute value of the t-statistic (-7.059) is less than the lower and upper essential t-values at the 5% level of significance further proves the existence of cointegration. Their p-values are statistically significant, which further proves that the level (order 0) and first-differenced (order 1) variables do not support the null hypothesis. Table 7 details the findings, which validate the cointegration and provide the groundwork for estimating the ECM.

Table: 7: Error correction estimates of the ARDL model for objective two

The dependent variable is livestock subsector agricultural output (LSOUTPUT)				
logLSOUTPUT	coefficients	Standard Errors	t-Statistics	P-value
Adjustment	-0.0508	0.0166	-3.06	0.000
Long-Run				
logLAON	0.1959	0.1045	3.87	0.000
CPI	0.0612	0.0171	3.56	0.000
logRAIN	-0.0115	0.1045	-0.11	0.913
POPG	1.7110	0.5609	3.05	0.000
Short-Run				
$logLSOUTPUT_{t-1}$	0.3845	0.2021	1.90	0.068
logLAON	0.0253	0.0127	1.99	0.057
CPI	0.0704	0.0205	3.43	0.000
logRAIN	-0.0004	0.0045	-0.09	0.929
POPG	0.2085	0.0625	3.34	0.000
Constant	0.0781	0.2738	0.29	0.778
R-squared			0.6460	
Adjusted R-Squared			0.4553	
Durbin–Watson d-statistic (15, 41)			2.0933	
Breusch–Pagan/Cook – Weisberg test for heteroskedasticity			3.047 (p = 0.0809)	

Source: Author's computation

According to the results, the error correction adjustment coefficient was -0.0508 and the t-value was -3.06. There is a negative and statistically significant coefficient that indicates the model's variables rebalance themselves towards long-run equilibrium at a pace of 0.05 percent per annum in the case of short-run disequilibrium.

The expected long-term coefficient for agricultural loans and advances from deposit money institutions was 0.1959, with a t-value of 3.87. Loans and advances to agriculture from deposit money banks do not significantly affect agricultural output in the livestock subsector, according to the null hypothesis. We reject this hypothesis, nevertheless, because the t-value is significant at the 5% level. For every one percent rise in agricultural loans and advances, there is a notable long-term increase of 0.19 percent in livestock subsector agricultural output, according to the data. In the short run, a t-value of 1.99 and a coefficient of 0.0253 revealed a positive but statistically insignificant connection. This suggests that a 0.03% increase in livestock subsector output is associated with a 1% increase in agricultural loans and advances issued to the sector by deposit money institutions, albeit the association is short-term and inconsequential. Loans and advances given to farmers by deposit money banks had a positive and statistically significant impact on livestock subsector agricultural output in the long run, whereas this effect was positive but not statistically significant in the short run.

Using the CPI over the long term, we find a t-value of 3.56 and a coefficient of 0.0612. Statistically, the t-value is significant at the 5% level, therefore we can say that the null hypothesis that the CPI has no effect on the livestock subsector's agricultural output in Nigeria is false. An increase of 0.06% for every 1% rise in the CPI is generated by the cattle subsector of the agricultural industry. Additionally, the consumer price index displayed a positive short-run coefficient of 0.0704 with a t-value of 3.46 at the 5% level of significance. The results demonstrate that there is a notable 0.07% rise in the agricultural output of the livestock subsector for every 1% increase in the consumer price index. As a result, both the short- and long-term effects of the consumer price index on agricultural output in the livestock subsector were positive and statistically significant.

With a t-value of -0.11 and a long-term rainfall coefficient of -0.0115, the result did not reach statistical significance at the 5% level. Accordingly, we accept as true the null hypothesis, which states that the livestock subsector of Nigeria's agricultural output is unaffected by annual rainfall. Specifically, for every year that rainfall increases, there is a little 0.01% drop in agricultural output from the livestock subsector, according to the data. The t-value for annual rainfall was -0.09 and the short-run coefficient was -0.0004, neither of which are significant at the 5% level of analysis. This finding provides short-term support for the null hypothesis, which states that increased annual rainfall has a small negative effect on livestock-related agricultural output. Therefore, annual rainfall had negative and negligible impacts on agricultural output in the cattle subsector in the long and short term.

At 1.7110, the long-run population growth coefficient has a t-value of 3.05 per cent. At the 5% level of significance, the t-value rejects the null hypothesis that population growth has no effect on agricultural output in the livestock subsector. Particularly, as a result of faster population growth, agricultural output in the cattle subsector jumped by 1.71%. Additionally, the result is positive and statistically significant in the short term, with a t-value of 3.34 and a coefficient of 0.2085. A substantial and favourable 21% increase in agricultural output from the livestock subsector was likely caused by a growth in the population. The livestock subsector's agricultural output, both in the long and medium term, was positively and severely impacted by population expansion.

The independent variables account for approximately 64.60 percent of the long- and short-term variation in agricultural output from the livestock subsector, as shown by the R^2 value of 0.6460. The remaining variation is explained by other factors that were not taken into consideration when developing the model. The Durbin-Watson test for autocorrelation yielded a value of 2.0933. This value is quite near to 2, suggesting that the absence of autocorrelation is statistically significant, hence we accept the null hypothesis. The Breusch-Pagan/Cook-Weisberg test for heteroskedasticity yielded a 3.047 coefficient and a p-value of 0.0809. The variables are considered to have constant variance under the null hypothesis of homoskedasticity since the p-value is not statistically significant at the 5% level.

Impact of Deposit Money Banks Loans and Advances to Agriculture on Nigeria's Overall Agricultural Output

The third goal-oriented model was created to assess how deposit money institutions' loans and advances impacted overall agricultural output. As a first step in the analysis, we ran the Bounds test to see if the three goal-specific variables in the model were level-connected (cointegrated). The results of the test are shown in Table 8.

Table 8: Bounds test result for the variables in the model for objective three

	10%		5%		1%		p-value	
	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)	I(0)	I(1)
F	2.585	3.949	3.153	4.715	4.525	6.551	0.002	0.001
t	-2.474	-3.589	-2.843	-4.020	-3.595	-4.898	0.000	0.000
F = 6.710 t = -6.510								

Source: Author's computation

Both the minimum and maximum critical values are exceeded by the computed F-statistic of 6.710, based on a 5% significance level. By rejecting the null hypothesis of no level link, cointegration among the variables is proven when it surpasses the upper bound. Cointegration is further supported by the fact that the t-statistic value (-6.510) is greater than the lower and upper critical t-values at the 5% level of significance. Their p-values are statistically significant, which further proves that the level (order 0) and first-differenced (order 1) variables do not support the null hypothesis. Table 9 displays the results of the error correction model (ECM) estimation, which validates the cointegration.

Table 9: Error correction estimates of the ARDL model for objective three

The dependent variable is Aggregate agricultural output (AGOUTPUT)				
logLSOUTPUT	coefficients	Standard Errors	t-Statistics	P-value
Adjustment	-0.0357	0.0142	-2.51	0.014
Long-Run				
logLAON	0.0664	0.0321	2.07	0.044
CPI	-0.0053	0.0171	-0.31	0.757
logRAIN	-0.2194	0.7247	-2.30	0.028
logGKEXP	0.7202	0.2988	2.41	0.019
Short-Run				
log $AGOUTPUT_{t-1}$	0.2562	0.0786	3.26	0.000
logLAON	0.0335	0.0112	2.99	0.003
CPI	0.0004	0.0007	0.56	0.577
logRAIN	0.0264	0.0066	3.95	0.000
logGKEXP	0.0838	0.0271	3.09	0.000
Constant	0.2660	0.0764	3.48	0.000
R-squared			0.7224	
Adjusted R-Squared			0.4114	
Durbin–Watson d-statistic (15, 41)			1.9050	
Breusch–Pagan/Cook – Weisberg test for heteroskedasticity			0.882 (p = 0.3477)	

Source: Author's computation

The results showed that the error correction adjustment coefficient was -0.0357 and the t-value was -2.51. Because this coefficient is negative and statistically significant, we can observe that in the presence of short-run disequilibrium, the model's variables tend to converge towards long-run equilibrium at a pace of 0.04% annually. Deposit money institutions' long-run projected coefficient for agricultural loans and advances was 0.0664, with a t-value of 2.07. The t-value is statistically significant at the 5% level, therefore rejecting the null hypothesis that says that the aggregate agricultural output is unaffected by the loans and advances given to farmers by deposit money institutions. Specifically, for every 1% rise in loans and advances to the sector, aggregate agricultural output grows by a considerable 0.07% over the long run, according to the data. A short-term positive and statistically significant correlation was revealed by a t-value of 2.99 and a coefficient of 0.0335. This suggests that a 1% increase in agricultural loans and advances from deposit money institutions is positively and statistically significantly correlated with a 0.03% increase in aggregate agricultural production in the short term. The loans and advances extended to the agricultural sector by deposit money banks had a beneficial and substantial impact on both the short- and long-term aggregate output of the industry.

The CPI's long-term t-value was -0.31 and its coefficient was -0.0053. Since the t-value is not statistically significant at the 5% level, we accept the null hypothesis, which states that the CPI does not significantly alter Nigeria's aggregate agricultural output. One specific example is the minuscule 0.01% decline in overall agricultural output that occurs for every 1% increase in the CPI. But in the near run, the CPI showed a positive coefficient of 0.0004 and a t-value of0.56, which is also not statistically significant at the 5% level. These results show that for every 1% increase in the consumer price index, total agricultural production rises by a pitiful 0.0004%. Agricultural output was positively affected by CPI in the near term and negatively affected in the long run, although both effects were not statistically significant.

At the 5% level of significance, a t-value of -2.30 and an estimated coefficient for yearly rainfall of -0.2194 show that there is a long-lasting relationship. Since annual rainfall does have a significant effect on aggregate agricultural output in Nigeria, we may reject the null hypothesis. The results of this study indicate that there is a long-term relationship between increased annual rainfall and a slightly lower overall agricultural output (-0.22%). At the 5% level of significance, the annual rainfall had a t-value of 3.95 and a short-run coefficient of 0.0264. In the short term, this finding disproves the null hypothesis and shows that an increase in annual rainfall significantly increases aggregate agricultural productivity. As a result, annual rainfall drastically decreased agricultural productivity over the long run while dramatically increased it over the short run.

A t-value of 2.41 and a long-run coefficient of 0.7202 characterize government capital spending. Given the statistical significance of the t-value, we can reject the null hypothesis at the 5% level. The underlying premise of this argument is that aggregate agricultural output is unaffected by government capital expenditure. Specifically, a rise in government capital spending led to a 0.72% increase in aggregate agricultural output. The short-term results are also positive and statistically significant, with a t-value of 3.09 and a coefficient of 0.0838. According to the findings, total agricultural production increased by 0.08% due to increasing government capital investment, which is a positive and statistically significant increase. There was a positive and statistically significant relationship between government capital investment and aggregate agricultural output over the short and long term.

A coefficient of determination (R^2) of 0.7224 indicates that the independent variables account for approximately 72.24 percent of the variation in overall agricultural output over both short and long time periods. The remaining variation is explained by other factors that were not taken into consideration when developing the model. The results of the Durbin-Watson test for autocorrelation were reported as 1.9050. This value is quite near to 2, suggesting that the absence of autocorrelation is statistically significant, hence we accept the null hypothesis. After calculating a coefficient of 0.882, the Breusch-Pagan/Cook-Weisberg test for heteroskedasticity produced a p-value of 0.3477. The variables are considered to have constant variance under the null hypothesis of homoskedasticity since the p-value is not statistically significant at the 5% level.

Conclusion

This study examined the impact of bank sector lending on agricultural output in Nigeria using the Autoregressive Distributed Lag (ARDL) model. According to the research, agricultural loan and advance programs offered by deposit money banks significantly boost crop yield over the long term while having minimal impact in the near term. Consumer pricing has favourable effects on agricultural output in the short and long term, suggesting that market incentives drive production. An example of weather variability is the positive but small negative impact of annual rainfall on agricultural productivity. Also, crop yield is driven by population expansion, even though it doesn't matter much in the short term.

A further finding is that agricultural loans and advances from deposit money institutions substantially boost cattle productivity in the long run, while having minimal impact in the short run. Both short-term shifts in the consumer price index and long-term increases in the population have a favourable effect on livestock productivity. The absence of effect on livestock output in both the short and long run suggests that annual rainfall has less of an impact on livestock productivity compared to other agricultural subsectors. Investments in fixed assets by the government and loans and advances from deposit money institutions are found to significantly boost aggregate agricultural production both immediately and over the long term. The impact of the consumer price index on agricultural output is minimal, both in the short and long term. It is important to use climate-resilient farming practices because, although annual rainfall reduces agricultural productivity in the long run, it has a favourable and significant impact in the near term.

Recommendations for Policy

It is suggested that you consider the following options:

i. To promote sustainable increase in agricultural output, the government should prioritise the expansion of long-term, accessible, and inexpensive agricultural financing. This would help with both crop and livestock production.
ii. To lessen reliance on rainfall in the long run and to stabilise pricing so that agricultural output increases can be sustained, officials should encourage climate-resilient farming practices and improve irrigation infrastructure.
iii. To ensure a steady increase in total agricultural production, policymakers should maintain or raise funding for agricultural infrastructure and related services.

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