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Funding Small Holder Farmers: Imperative For Inclusive Growth In Nigeria

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Abstract
This study investigated the impact of agricultural financing on agricultural output in Nigeria from 1981 to 2022. Ex-post facto research design was adopted in the research. Multiple regression analysis was used in which the autoregressive distributed lag (ARDL), dynamic ARDL simulation and Kernel-Based Regularized Least Squares (KRLS) models were employed to analyze the variables utilized in the research. Time series data collated from the statistical bulletin of the Central Bank of Nigeria (CBN) and World Bank Development Indicators (WBDI) on agricultural output, cocoa farming financing, crops farming financing, foreign personal remittances, and inflation rates were analyzed in the study. The results revealed that cocoa farming financing, crops farming financing and foreign remittances had significant and positive average marginal impacts on agricultural output in Nigeria. On the above notes, the study recommended that government should guarantee more sufficient funds on cocoa farming activities with adequate monitoring of the credit guaranteed to the sub-sector. By so doing, the commercial banks will devote more loans for cocoa production in the economy, and hence, boost cocoa agricultural output and promotes its exports in Nigeria. Similarly, government should encourage more foreign personal remittance inflows in the economy by removing all policies that hinder inflows of personal remittances such as dispensing of local currency in exchange for foreign currency sent back to home country by migrants, and other obnoxious charges on foreign remittance inflows. In so doing, migrants will be encouraged to send more remittances to their relatives that will in turn, use same for farming activities and promote agricultural output in the economy.
Keywords*: Role, Agricultural, Financing, Output, Growth*

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I. Introduction

Naturally, Nigeria is endowed with abundant resources including both human and physical resources. To harness these all important potentials for the growth and development of the economy, the international donors in their financial aids; prioritized small farm holders and other small and medium scale enterprises (SMEs) in its interventions in the economy. Agriculture in Nigeria constitutes one of the most essential sectors in the economy. The sector is specifically important in terms providing employment opportunities and promoting gross domestic product as well as generating export revenue earnings (Mu'azu, & Lawal, 2017). Nigeria was rated as an agrarian economy prior to the shifted to the oil exports in the 1970s, as agriculture contributes 40 percent of the gross domestic product (GDP) and engages about 70 percent of the working population (FMARD, 2012). Notwithstanding the Nigerians abundant agricultural resource endowments, the sector has been growing at a very low rate. In the pre- and post-independence eras of Nigeria in Africa, small farmers exhibit uniqueness in farming activities, as they were allowed free access to land or relatively it can be used at a lower cost (Mu'azu, & Lawal, 2017). According to Mgbenka and Mbah (2016), low cost land avails farmers the apple opportunity of accessing land at all time for the purpose of agricultural production, probably at lower cost structure.

Thus, the role of agricultural financing in the acceleration of agricultural production in promoting economic growth and development cannot be overstated. Olomola (1997) pointed out that agricultural credit guarantee system is often considered as an effective policy tool in facilitating the production and distribution of agricultural commodities. This argument was affirmed by Nnanna (2004) who supported that credit finance played an important role in output production of the agricultural sector more than other factors such as land, labour, equipment and raw materials since it can be utilized to acquire all factor inputs. Mu'azu and Lawal (2017) in their arguments emphasized that inadequate financing agricultural sector causes a decrease in agricultural production. If the claims happened to be true, it cast doubts about the assertion that effectiveness of agricultural financing institutions and programmes which are often initiated specifically to provide guaranteed credits to farmers accelerate agricultural production.

Therefore, accessing agricultural credits are very essential for agricultural output and rural development in Nigeria, as about 70 percent of the population live in the rural areas with their major source of livelihood revolving around agriculture (Egwu, 2016). Credit constraints to farmers, thus, impose high costs on the society. It results in high rate of rural unemployment, rural poverty, distortion of agricultural production, liquidation of assets and above all, leads to food insecurity and high food prices in the country. As a result, governments across countries of the world both the developed and developing countries, Nigeria in particular, has over time, strives to overshadow these problems by subsidizing credits to agricultural sector by setting up credit guarantee scheme funds such agricultural credit guarantee scheme funds (ACGSF) established in 1977 and specialized agricultural credit bank such as Nigerian Agricultural Cooperative Bank (NACB) introduced in 1990 as an agricultural financing institution, now known as the Nigeria Agricultural Co-operative and Rural Development Bank (NACRDB), and Bank of Agriculture (BOA). Others include Some of which were the Bank of Agriculture (BOA) introduced in 2000 to provide credits to micro, small and medium scale agricultural farmers, Small and Medium Enterprises Equity Investment Scheme (SMEEIS) established in 2001, Refinancing and Rediscounting Facility (RRF), 2002, Agricultural Credit Support Scheme (ACSS), 2006, Anchor Borrowers' Programme (ABP) launched in 2007, commercial agriculture credit scheme enunciated in 2009, Large Scale Agricultural Credit Scheme (LASACS), 2009, and other stimulating institutional innovations in the financial system (Egwu, 2016). These agricultural financing policies were established with the aim of improving agricultural production and as well diversifying the economy of Nigeria away from oil sector; and to ensure that value addition and income from the agricultural output remains relatively high and contributes largely to nation's GDP (Odili, 2022). However, many banks saw agricultural credit as a very risky venture and seek to devote their credits to less risky sectors. This attitude beckons for an empirical study in Nigeria.

Furthermore, farm householders in Nigeria are quite heterogeneous considering their resource endowments, production and consumption opportunities. Hence, lenders often require information that analyzes the potential credit worthiness of the borrowers before letting out their credits to them. Thus, agricultural sector if adequately harnessed ensures supply agro-based industrial inputs; generate employment to the unemployed teeming population and sustainable economic growth in the economy. Agricultural financing according to Duong and Izumida (2002), plays an important role in agricultural development. Hence, agricultural credit is one of the major inputs in the development of agricultural sector. This confirms the Cobb-Douglas production function, which captures labour and capital as major factors responsible for improved agricultural productivity in an economy.

In Nigeria, about 88 percent of agricultural activities comprise small farmers who live below USD 1.9 poverty line (Duong & Izumida, 2002). Agricultural sector in Nigeria comprises cash crops, livestock, fishery and food crops. Cash crops consist of oil palm, rubber, cocoa, cotton and groundnut, whereas livestock include poultry, cattle rearing and sheep, among others. Food crops on the other hand, include beans and soya beans, vegetables, grains, and roots and tubers. At independence in 1960, the agriculture was the main anchored of the Nigerian economy, contributing over 40 percent of the total GDP, 70 percent of the employment generations, and main source of government revenue (Odili, 2022). But with the discovery of crude oil in commercial quantities and its attendant oil boom in the 1970s, oil sector took over the position of the agricultural sector, as it now became the foreign exchange earner of the Nigeria's economy. To revamp the economy on the way of the prosperous agricultural economy, successive governments of Nigeria as mentioned earlier implemented agricultural credit and other related policies. The policies include the agricultural credit guarantee scheme funds established in 1977, commercial agriculture credit scheme launched in 2009, among others, mainly to facilitate small scale farming and promote agricultural output in Nigeria.

Notwithstanding the efforts, Nigeria is still struggling with agricultural output growth in the country with high rates of poverty, unemployment, high food prices food insecurity still ravaging the economy. For instance, credit guaranteed fund for cocoa growth rate was reported -78.5 percent, it fell to -43.5 percent in 2000; and by 2010, cocoa guaranteed funds declined to -78 percent and improved to 34.9 percent in 2022. Poultry growth rates stood at -33.5 percent in 1990 but declined to -43.5 percent in 2000, and -7.4 percent in 2010 and recorded 31.7 percent improvement in 2022. Furthermore, the cattle rearing recorded -40 percent in 1990 and increased to 155.7 percent in 2000 and by 2010, the growth rate declined to -50.1 percent and 102.7 percent in 2022 (CBN, 2022). In 1990, crops production stood at 8.5 percent, and rose to 44.9 percent in 2000, increased to 473.5 percent in 2010 but it declined to 18.98 percent in 2022. Similarly, foreign remittances growth rate in 1990 stood at -1.7 percent and increased to 6.96 percent in 2000, it rose again to 7.5 percent in growth rate in 2010, and in 2022, the growth rate of the foreign remittances declined to 3.3 percent. On the other hand, the output of agricultural sector was 20.8 percent in 1990, and however, fell to 5.7 percent in 2000, and 12.2 percent in 2010 and in 2022, the agricultural output increased to 34.9 percent

From the facts above, the trend analyses show that agricultural financing contradicts a prior expectation, which upheld that improvement in expenditure on agriculture tends to increase agricultural output. The study observed from trend analyses that agricultural financing increases but suddenly exhibits fluctuations as agricultural output maintained increases without following the trend movements. This situation violates economic theory, and it is very unhealthy for an economy striving for agricultural development. The consequences of the situation food insecurity, high food prices, high unemployment rate, high poverty level, food import dependency, lower living standard, inadequate supply of industrial inputs and unstable economic growth. It is against these problems that this study investigates the influence of agricultural financing on agricultural output in Nigeria.

II. Theoretical Framework

The theoretical framework of this study is anchored on the Cobb-Douglas production function and Joseph Schumpeter theory of finance and growth unveiled in 1911. These theories provide adequate explanation of the nexus between agricultural financing and agricultural output in the economy.

Cobb-Douglas Production Function

The Cobb-Douglas production function adopts agricultural production function in the production processes. The function held that farmers only consumes goods it produces, and the production of each products requires the input of farmer members' time and other purchased inputs (Becker, 1965). Hence, the Cobb-Douglas production function is component of the household production theory. The Cobb-Douglas production function is expressed below:

$Q = AL^{\beta} K^{\alpha}$ 1

Where; Q denotes output quantity produced, L represents number of the labour force engaged in the production processes, K is the capital input used in production processes, while A is the technological progress used in the production process, which captures variables that account for efficiency in farm output not caused by traditionally measured inputs of labour and capital; β and α are the output elasticities of labour and capital. The Cobb-Douglas production function shows that farm output in the economy is a function of factors of production such as labour and capital which are combined in the agricultural production processes.

This theoretical framework is relevant to this study as it adequately explains how agricultural output production is dependent on effective combination of labour, capital and technological progress in the production processes. In Nigeria, agricultural activities are pre-dominated by smallholder farmers who practiced agricultural activities with government and commercial banks providing the required credits for its development in the economy.

Schumpeter Theory of Finance-led Growth

Schumpeter (1911) developed the theory of finance and growth which holds financial system as an important factor that propels growth of output, agricultural output inclusive by allocating savings, motivating innovation and funding productive investments in the economy. The theory further opines that funds from the credit market are as well crucial in supporting the development of output as it encourages specialization in entrepreneurship in addition to the adoption of new technology (Greenwood & Smith, 1997). Both credit and stock market development accelerate growth of production in the economy. In 1911, Joseph Schumpeter postulated that the services provided by financial intermediaries in the mobilization of savings, managing risk, evaluating projects, monitoring managers and facilitating transactions are very essential for technological innovation which in turn, causes economic development. The Schumpeterian growth model was based on three major concepts, which include long-run growth outcome from innovations; innovations resulting from entrepreneurial investments that are internally motivated by the prospects of monopoly rents; and new innovations that replaced old technologies (Philippe, Ufuk & Peter, 2015). The model is as follows:

$Y = Ay^{a}$, 2

Where, Y is the output growth, A represents the current quality of the input, which is multiplied by a factor Y > 1 each time a new innovation is achieved.

Empirical Review

In view of the foregoing discussion, several studies were reviewed to ascertain the influence of agricultural financing on agricultural output. For example, some of these studies were conducted across countries of the world using different modeling and econometric methods. The outcome of the reviewed studies indicated that agricultural financing, cocoa farming financing in particular had significant and positive impacts on agricultural output; and the studies include Yusuf, Adeniran and Adeagbo (2020), Balogun and Obi-Egbedi

(2012), Odili (2022), Abbas (2021), Egwu (2016) and Abdulrafiu and Abigail (2022), while Oyakhilomen, Omadachi and Zibah (2012); and Kouadio, Anani, Faye and Fan (2023), Anthony, Jonathan, Jennifer and Onyinye (2021), Mu'azu and Lawal (2017) and Ewubare and Ozar (2018) found that cocoa farming financing had no significant impact on agricultural output.

Similarly, studies reviewed on the influence of agricultural financing with focus on crops farming financing on agricultural output indicated that crops farming financing significantly and positively affected agricultural output in the economies, and these studies were Abu (2024), Golley and Samuel (2021), Akinuli and Osagiede (2023), Sule, Gana and Abdullahi (2023), Nakazi and Sunday (2020), Primus (2019), Chris, Mbat and Stephen (2016), Egwu (2016), Okore and Anthony (2022), Olorunsola, Adeyemi, Valli, Kufre and Ochoche (2017), Agu and Agu (2018), Adewale, Lawal, Aberu and Toriola (2022), Unal and Semih (2020) and Evans (2017), whereas Abdul, Saheed, Abraham, Bernard and Yakubu (2022), Anthony, Jonathan, Onyinye and Jennifer (2020); Mohammed and Yogesh (2022) showed that crops farming financing had no significant influence agricultural output in the economy.

Employing unit root test and autoregressive distributed lag (ARDL) estimation method, Romanus, Ngozi and Tyrone (2020) and Eke-Okoro et al., (2014), James, Isaac, Joshua and Bukari (2020) and Falaye (2023) investigated the influence of foreign remittances on agricultural output using various modeling and methods of analyses. The study was tailored towards exploring the influence of personal remittances on agricultural output. The results showed foreign remittances had significant and positive impact on agricultural output in the economies.

Gap in Literature

Gap in empirical review of this study is established mainly on location and methodological perspectives. On location gap, the study reviewed various studies such as Nakazi and Sunday (2020), Unal and Semih (2020), Kouadio, Anani, Faye and Fan (2023), James, Isaac, Joshua and Bukari (2020). Some of these studies were carried out in foreign countries such as Indonesia, Rwanda, ASEAN countries including USA, UK, China, France, Rusia and Germany. Thus, they investigated the effect of agricultural financing on agricultural output in the various economies. However, this study differs from these studies by domesticating these studies in the Nigerian economy with the variables combined to determine their influence on agricultural output in Nigeria.

On the methodological gap, it was discovered from the studies reviewed that scholars such as Yusuf, Adeniran and Adeagbo (2020), Odili (2022), Abbas (2021), Abdulrafiu and Abigail (2022), Kouadio, Anani, Faye and Fan (2023) and Anthony, Jonathan, Jennifer and Onyinye (2021) carried research on closely related topics by specifying agricultural output as a function of agricultural credit guarantee scheme funds (ACGSF) and commercial bank credits to agriculture. However, this study improved on these studies by disaggregating ACGSF in agricultural financing into cocoa farming financing (cash crops) and crops farming financing, included foreign remittances in the model due to its role in financing agriculture in Nigeria. In terms of the estimation method, the study used Autoregressive Distributed Lag (ARDL), Dynamic ARDL simulation and Kernel-Based Regularized Least Square (KRLS) methods as against the traditional ARDL model, OLS, VAR model, Johansen cointegration test and VECM method utilized by other studies due to their inherent advanced method and advantages.

III. Methods

Theoretical Model

The model specification is anchored on the Cobb-Douglas production theoretical model. The Cobb-Douglas production model recognizes output growth of agriculture as a function of labour, capital and technological progress combined in the production processes. Thus, the Cobb-Douglas production function model is specified as follows:

$Q = AL^{\beta} K^{\alpha}$ 3

Where; Q = number of output produced, L = number of labour force used in the production processes, K = capital input used in production and A = technological progress, which captures variables that account for effective method used in farm output excluding the traditionally measured inputs of labour and capital; β and α are the output elasticities of labour and capital. This model was captured in the work Abbas (2021) in his study. In his model, the total factor production function was specified thus:

$Q = f(AL^{\beta}, K^{\alpha})$ 4

To capture the objective of this study, the equation 4 is modified in functional form as:

$AO = f(CA, CP, FRMT, INF)$ 5

In linear function, the model is specified thus:

$AO_t = \emptyset_0 + \emptyset_1 CA_t + \emptyset_2 CP_t + \emptyset_3 FRMT_t + \emptyset_3 INF_t + \mu_t$ 6

In logarithm function, the model is expressed as:

$$\ln AO_t = \emptyset_0 + \emptyset_1 \ln CA_t + \emptyset_2 \ln CP_t + \emptyset_3 \ln FRMT_t + \emptyset_4 lNF_t + \mu_t \quad 7$$

Where, AO = Agricultural output, while CA = Cocoa farming financing, CP = Crops farming financing, FRMT = Foreign remittances, INF = Inflation rates, $\emptyset_0$ = constant term, ut = error term and $\emptyset_{is}$ are the parameters of the equations.

A Priori Expectation

Theoretically, the study expects all the independent variables except inflation rates to have positive nexus with agricultural output. The a priori expectation behavior expressed as: φ1>0, φ2>0, φ3>0> φ4>0, φ5>0, φ6>0.

Sources of Data

Time series data sourced from the CBN Statistical Bulletin, volume 33, 2022 are employed to realize the objectives of this study. The time scope is between 1981 and 2022.

Estimation Procedure

The estimation procedure used in this study includes:

Unit root test

Unit root test: The Augmented Dickey-Fuller (ADF) Unit Root test

The prevailing way of detecting non-stationarity variable is described as unit root test. The Dickey and Fuller (1979) is based on the model below:

$$Y_t = \beta_0 + \beta_1 y_{t-1} + Yt + \varepsilon_t \quad 8$$

Rewriting the equation, we have:

$$\Delta Y_t = \beta_0 + (\beta_1 - 1) y_{t-1} + Yt + \varepsilon_t \quad 9$$

Where $\Delta Y_t = Y_t - y_{t-1}$. The time series is assumed non-stationary if the coefficient of y_{t-1} is equals zero, the series is then difference-stationary; and if the coefficient of t is not equal to zero, the series is trend stationary. One of major properties of the Dickey-Fuller test is that the error term is not correlated but if it is correlated, more lagged values of y_t is included on the right hand side of the equation 9. Rewriting equation 9, we have the Augmented Dickey-Fuller (ADF) model.

Unit root test: Zivot-Andrews (Zandrews) test

Zivot and Andrews (1992) modified the Phillips-Perron unit root test which is based on an exogenously determined break date into an unconditional unit root test. Here instead of treating the break date as fixed, the test estimated the break date. Zivot and Andrews applied the intervention outlier model for changing growth model instead of the additive outlier model by Phillips-Perron. The regression model is as follows:

$$\hat{y}^B{}_t = \hat{\alpha}^B \hat{y}^B{}_{t-1} + \sum_{i=1}^{k} \hat{C}_i{}^B \Delta \hat{y}^B{}_{t-1} + \hat{\varepsilon}_t \quad 10$$

Where $\hat{y}^B{}_t$ are the residuals from a regression with y_t as the dependent variable and where the independent variables contains a constant, time trend and deterministic trend. More so, it treated the structural break as an endogenous occurrence and the null hypothesis for the model is given as:

$$y_t = \alpha_0 + y_{t-1} e_t \quad 11$$

The selection of breakdown for the variable was viewed as an outcome of an estimation procedure that is designed to fit y_t to a certain trend stationary representation. Zivot and Andrews assumed that the alternative hypothesis specifies that y_t can be a trend stationary process with one break in the trend which occurs at an unknown point in time.

Auto regressive distributed lag (ARDL) model

The autoregressive distributed lag model is used to estimate the short-run and long-run coefficients of the variables employed in the study. It becomes necessary as the stationarity test indicated mixed order of integration among the variables, that is, order one and order two, as recommended by Pesaran and Smith (2001), among others. The model of the ARDL in generic form is specified thus:

$$\Delta AO_t = \beta_0 + \Sigma\, \beta_i \Delta AO_{t-i} + \Sigma\gamma_j \Delta CA_{1t-j} + \Sigma\delta_k \Delta CP_{2t-k} + \theta_0 FRMT_{t-1} + INF_{2t-n} + e_t \quad 12$$

In the equation 12, the generic ARDL model showed that the equation is characterized by lags of the dependent variable and as well lags perhaps the current value of the regressors.

Dynamic Autoregressive Distributed Lag (DARDL) Simulation Model

The dynamic simulation provides for testing model's coefficients by conveying the statistical importance of the estimates through situations that are realistic counterfactual. While holding other explanatory variables fixed, it simulates, estimates, and graphs the prediction of counterfactual changes in one explanatory variable on the dependent variables. The ARDL model with dynamic simulations is used in the study's econometric analysis due to its numerous advantages. Hence, the ARDL model in general is specified below:

$$\Delta Y_t = \alpha_0 + \theta_0 y_{t-1} + \theta_1 x_{1t-1} + \cdots + \theta_k x_{kt-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-1} + \sum_{j=0}^{q_1} \beta_{1j} \Delta x_{1t-j} + \cdots + \sum_{j=0}^{q_k} \beta_{kj} \Delta x_{kt-1} + \varepsilon_t$$

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Two of the most common restrictions are the ARDL(1,1) model with all-stationary data:

$$y_t = a_0 + \varphi_1 y_{t-1} + \theta_{1,0} x_{1,t} + \cdots + \theta_{k,0} x_{k,t} + \theta_{1,1} x_{1,t-1} + \cdots + \theta_{k,1} x_{k,t-1} + e_t$$

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Also to be estimated is its non-stationarity and cointegrating variant, referred to as an error correction model with the following model:

$$\Delta y_t = a_0 + \varphi_1 y_{t-1} + \theta_{1,1} x_{1,t-1} + \cdots + \theta_{k,1} x_{k,t-1} + \beta_1 \Delta x_{1,t} + \cdots + \beta_k \Delta x_{k,t} + e_t$$

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Equation 12 demonstrates the first difference of the dependent variable y_t at time t = 1, 2,..,T as a function of an intercept (a_0), the first lag of the regressed in levels (y_{t-1}), the first lag of regressors in levels, x_{1t-1}, x_{2t-1}, . . . , x_{kt-1}, and up to maximum lags p and q_i, i = 1, 2, . . . , k of the first differences of dependent and independent variables, with an error term e_t. The first differences are included to account for autocorrelation and delayed effects.

Kernel-Based Regularized Least Square (KRLS) Model

After the dynamic ARDL Simulations estimated, the study subsequently applies Kernel-based Regularized Least Squares (KRLS), a machine learning algorithm that implements the pointwise derivatives to examine the causal-effect relationship. The mathematical elaborations of the technique can be found in Hainmueller and Hazlett (2014). To account for future economic performance, the study examine the structural adjustments in economic growth using empirical estimation via pointwise marginal effect.

$$k(xj\ , xi) = e^{-\frac{IIx_j - x_iII^2}{\sigma^2}} \qquad 16$$

Where e^x is the exponential function and $IIx_j - x_iII$ is the Euclidean distance between the covariate vectors x_j and x_i. This function is the same function as the normal distribution, but with σ^2 in place of $2\sigma^2$, and omitting the normalizing factor $1/\sqrt{2\pi\sigma^2}$ The most essential feature of the kernel model is that it gets to its maximum of one only when $x_i = x_j$ and grows closer to zero as x_i and x_j become more distant. More so, $k(xj\ , xi)$ is the measure of the similarity of x_i to x_j. Under the "similarity-based view," it is asserted that the target function y =f(x) can be approximated by some function in the space of functions represented by:

$$f(x) = \sum_{i=1}^{N} C_i k(x, x_i) \qquad 17$$

where $k(x, x_i)$ measures the similarity between our point of interest (x) and one of N input patterns x_i, and c_i is a weight for each input pattern. The key reason behind this approach is that it does not model y_i as a linear function of x_i. Rather, it leverages information about the similarity between observations.

IV. Results And Discussions

This subsection deals with the results estimated using econometric methods and subsequently discusses in accordance with the objectives of the research. The results are as expressed below:

Table 1: Unit Root Test

Variables	Level.ADF	Δ.ADF	Level.ZA	Δ.ZA	Rank
lnAO	-2.212	-4.081**	-3.210	-4.932**	I(1)
lnCA	-1.450	-8.701**	-4.759	-5.908**	I(1)
lnCP	-1.000	-11.283**	-2.601	-12.057**	I(1)
lnFRMT	-0.940	-6.532**	-3.402	-8.313**	I(1)
INF	-3.050*	-5.903**	-5.014*	-8.088**	I(0)

Sources: Computation from Stata 16.0

Where Level.ADF and Δ.ADF unveil stationarity test at both level and first-difference of the Augmented Dickey-Fuller unit root test; whereas Level.ZA and Δ.ZA show both the level and first-difference of Zivot-Andrews structural adjusted unit root test; * and ** indicate rejection of H_0 at 5% significance level. The results in Table 1 showed that all the variables except inflation rates were not stationary at level at both the ZA and ADF unit root tests. However, at first differencing, the non-stationarity variables became stationary.

Optimal Lag Length Criteria

Table 2: Selection-Order Criteria

Lag	LL	LR	Df	P	FPE	AIC	HQIC	SBIC
0	-401.622				1355.35	21.4011	21.4778	21.6166
1	-234.219	334.81	25	0.000	0.763534	13.9063	14.3662*	15.1991*
2	-209.719	49	25	0.003	0.8423	13.9326	14.7759	16.3028
3	-178.08	63.279	25	0.000	0.721038*	13.5831	14.8098	17.0307
4	-145.254	65.651*	25	0.000	0.724111	13.1713*	14.7812	17.6962

Source: Computation from Stata 16.0

Table 2 shows the results of the optimal lag length selection-order criteria. From the Table, the optimal lag length selected is lag 4 with main focus on the Akaike information criteria (AIC).

Autoregressive Distributed Lag (ARDL) Model Estimation

The autoregressive distributed lag (ARDL) estimation is engaged to find the long-run equilibrium and long-run nexus between the variables under review. The results are as shown in the Tables below:

Table 2: ARDL Estimation Model

EQN	COEF.	Estimate	SE	t-Stat	P-Value	Min 95	Max 95
ECT	$lnAO_{t-1}$	0.1512831	0.0667054	2.27	0.034**	0.0125616	0.2900045
Long-Run	$lnCA_{t-1}$	0.1837261	0.1486928	1.24	0.230	-0.1254975	0.4929498
	$lnCP_{t-1}$	0.4706095	0.2943849	1.60	0.125	-0.1415974	1.082816
	$lnFRMT_{t-1}$	0.238141	0.1951756	1.22	0.236	-0.1677488	0.6440309
	INF	-0.0891704	0.031617	-2.82	0.010	-0.1549215	-0.0234192
	_Cons	-4.779428	1.621222	-2.95	0.008	-8.150943	-1.407913
Short-Run	L2ΔlnAO	-0.613338	0.1853246	-3.31	0.003**	-0.9987415	-0.2279344
	LΔlnCA	0.0315457	0.0189966	1.66	0.112	-0.0079599	0.0710514
	LΔlnCP	0.1193345	0.0394574	3.02	0.006**	0.0372783	2013907
	LΔlnFRMT	-0.0789106	0.0382359	-2.06	0.052	-0.1584265	0.0006054
	LΔINF	-0.0041672	0.001952	-2.13	0.045**	-0.0082265	-0.0001078
ARDL(3,2,3,2,2)	**OBS**	**38**		**R^2**	**0.7553**	**Root MSE**	**0.1036**

Source: Computation from Stata 16.0

Table 2 shows the ARDL estimation results, in which SE denotes standard error; ** indicates statistical significance at 5% level. The results unveiled that the guaranteed funds on cocoa with coefficient of 0.1837261 and crops with coefficient 0.4706095 farming, and foreign remittances with coefficient 0.238141 had no significant impact on agricultural output with the p-values of 0.230, 0.125 and 0.236, respectively, while inflation rates with coefficient of -0.0891704 had significant (with p-value-0.010) and negative effect on agricultural output in the long-run. It was also indicated that guaranteed funds on cocoa farming with coefficient of -0.613338) exerts no significant influence on agricultural output at lag difference in the short-run, whereas crops farming with coefficient of 0.1193345 at lag difference had significant (0.006) and positive impact on agricultural output. Similarly, the results indicated that foreign remittances at lag difference had not impacted on agricultural output significantly (0.052) in the short-run while inflation rates at lag difference exert significant (0.045) and negative (-0.0041672) effect on the agricultural output in the economy.

In the same way, the error correction term ECT(-1) is indicated as 0.1512831 with a p-value of 0.034. The coefficient of the ECT term shown as the speed of adjustment is fractional, negative and statistically significant. As expected, the coefficient borders around -1 and 0 for convergence to occur. It, therefore, indicates that lnAO adjusts to lnCA, lnCP, lnFRMT and INF in the long run equilibrium nexus. Thus, the system corrects its disequilibrium in the short-run at a speed of 15.1% towards long-run relationship annually. Similarly, the value of the multiple coefficient of determination (R^2) is 0.7553, implying that 75.5% of the changes in the agricultural output is explained for by the independent variables, as the remaining 24.5% is accounted for by other variables excluded from the regression model. more so, root mean square error (Root MSE) of 0.1036 is unveiled in the estimation results, indicating that the low average prediction error in the estimation results.

ARDL Bounds Test

Since the unit root properties of the sampled variables alongside the estimation of the variables via the ARDL model, the study proceed to determine the cointegration rank through the modified Pesaran, Shin, and Smith (2001) ARDL bounds test with Kripfganz & Schneider critical values. Based on ARDL (3,2,3,2,2), the results are shown below:

Table 3: Pesaran, Shin, and Smith bounds test

K		10%		5%		1%		P-value	
		1(0)	I(1)	1(0)	I(1)	1(0)	I(1)	1(0)	I(1)
F	5.885	2.361	3.607	2.878	4.315	4.159	6.053	0.001**	0.012**
t	2.268	-2.447	-3.570	-2.829	-4.021	-3.619	-4.952	0.999	1.000

Source: Computation from Stata 16.0

In Table 3, I(0) and I(1) reveal the lower and upper critical band at 10%, 5% and 1% level of significance of the Pesaran, Shin, and Smith ARDL bounds test; P-value is indicated by Kripfganz and Schneider critical values and approximate P-values; ** indicates rejection of the H_0 of no level nexus at 5% significance level.

Diagnostic Tests

The diagnostic tests were carried out to test for structural serial correlation, validity and stability in the regression equations utilizing the Breusch-Godfrey LM serial correlation, heteroscedasticity, Ramsey Reset and cumulative sum residual tests. The results are as presented in the Tables below:

Table 4: Breusch-Godfrey LM Test for Autocorrelation
H_0: No Serial Correlation

lags(*p*)	Chi2	Df	Prob > chi2
1	0.076	1	0.7824

Source: Computation from Stata 16.0

Table 5: Heteroskedasticity Test
H_0: No ARCH Effects

lags(*p*)	Chi2	Df	Prob > chi2
1	0.013	1	0.9085

Source: Computation from Stata 16.0

Specification Test

Ramsey RESET test using powers of the fitted values of D.gdp
Ho: model has no omitted variables

Table 6: Ramsey RESET test

F(3, 20)	Prob > F
2.44	0.0976

Source: Computation from Stata 16.0

Considering the fact that the dynamic ARDL simulations require the dependent variable to be stationary at first difference I(1), this study conducted several tests to overcome the problems of serial correlation, heteroskedasticity, model miss-specification and violation of normality conditions. From the results in table 4, the LM test unveiled a chi-square value of 0.076 with a p-value of 0.7824, showing no evidence of serial correlation in the regression equation at 5% significance level. Similarly, Table 5 tested for heteroskedasticity constant distribution of error term in the estimation model and the results revealed a Chi-square value of 0.013 with a p-value of 0.9085, implying that the residuals of the regression model are homoscedastic at 5% significance level. Again, the study tested for miss-specification model using Ramsey Reset test, and the results showed an F-statistic value of 2.4 4and a p-value of 0.0976, which indicated that the model has not omitted important variables in the model specification. Hence, the model is well specified.

Stability Test

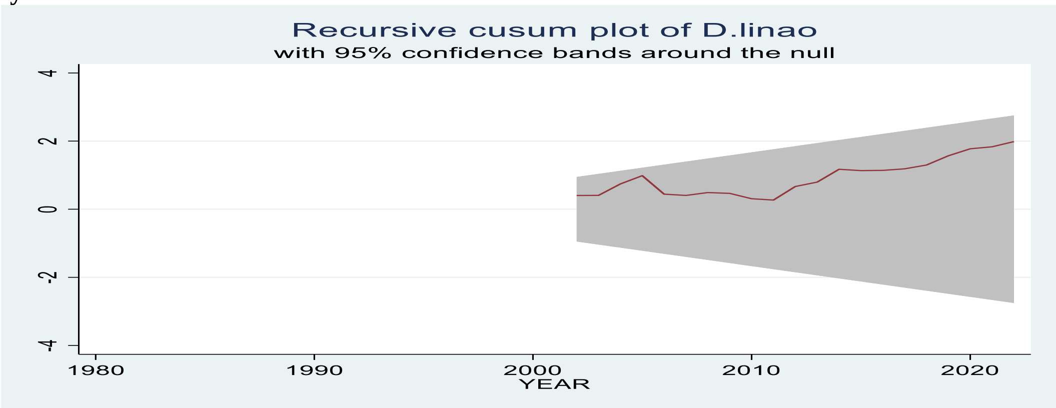


Figure 1: Cumulative Sum (CUSUM) of Residuals Test

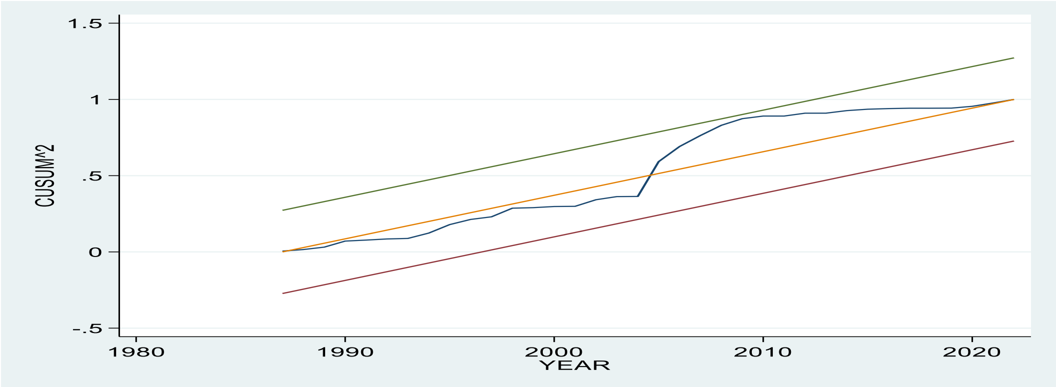


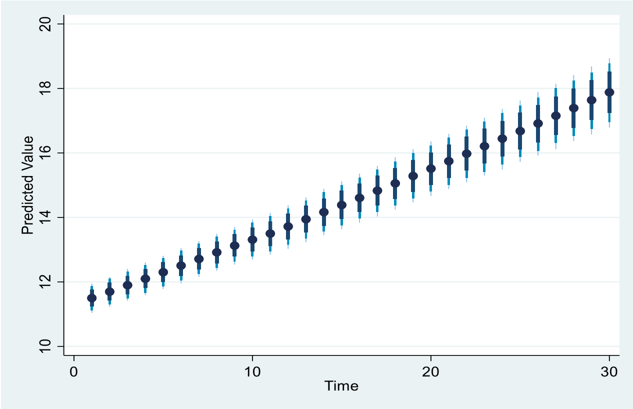
Figure 2: Cumulative Sum (CUSUM) of Square Test

The cumulative sum (CUSUM) of residuals test is used to identify structural changes in the coefficients of regression model, while the cumulative sum of squares (CUSUMSQ) test for sudden changes in the constancy of the regression coefficients. From Figures 1 and 2, the results revealed stability in the parameters of the model both at the CUSUM residuals and the CUSUMSQ as the plots lie within critical bands at a 5% significance level.

Dynamic ARDL Simulated model

The dynamic ARDL simulations method accounts for future shocks in the economic indicators. The simulated model is based on -1% contributions used as counterfactual shock over 30 years from 2022 onwards. The plots of the dynamic simulated ARDL are captured in Figures 3 to 5 whereas the expounded empirics are represented in Table 7 to 9.

Predicted lnAO with -1% Δ in lnCA **Predicted lnAO with -1% Δ in lnCP**



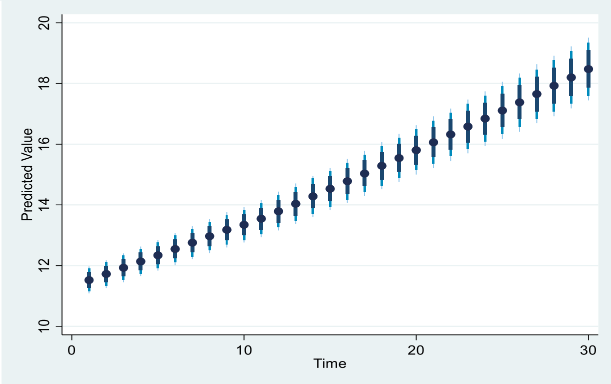


Figure 3: counterfactual shock of lnCA in predicted lnAO
Figure 4: counterfactual shock of lnCP in predicted lnAO

Predicted lnAO **with -1% Δ in lnFRMT**

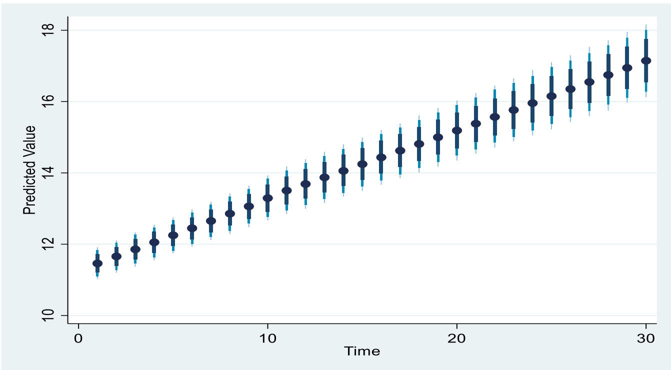


Figure 5: counterfactual shock of lnFRMT in predicted lnAO

The plots in Figures 3 to 5 portray the dynamic ARDL simulations, which show that -1% shock in cocoa and crops farming credits and foreign remittances will not have much effect on agricultural output in the first period; however, in the long-run, growth prediction accelerates. Hence, a negative percentage change in cocoa and crops farming and foreign remittances policies in the first period will have adverse effect but the transformation on sustainable growth will not last long. From the plots, the black dotted line indicate the predicted agricultural output by -1% shocks in and crops farming and foreign remittances in a log-log model, whereas the coloured regions, from darkest to lightest shows the 75, 90, and 95 confidence intervals of the predictions from the simulations.

Table 7: Expounded Dynamic ARDL Simulation Model for lnCA, lnCP and lnFRMT

DARDL	Coeff.	SE	P-Value	Min 95	Max 95
L1lnAO	0 .0057175	0.0503163	0.910	-0.0977091	0.1091441
ΔlnCA	0.0212276	0.0240375	0.385	-0.0281822	0.0706373
ΔlnCP	0.0437065	0.0373259	0.252	-0.033018	0.1204309
ΔlnFRMT	-0.0257356	0.0372009	0.495	-0.1022031	0.050732
ΔINF	0.0044366	0.0019784	0.034**	0.00037	0.0085032

Cons	-0.1059448	0.4344064	0.809	-0.9988799	0.7869903
F > Prob.	**0.0172****	**R^2**	**0.5683**	**Root MSE**	**0.12387**

Source: Computation from Stata 16.0

The results showed that cocoa and crops farming guaranteed funds have a positive effect on agricultural output while foreign remittances have negative shocks accounting for 0.01, 0.02 and -0.03 percent shocks on agricultural output in Nigeria. More so, results revealed that inflation rates shock is negative explaining 0.004 percent shocks in increase in agricultural output in Nigeria.

Kernel-Based Regularized Least Squares (KRLS) Estimates

The KRLS model implements pointwise derivatives mainly to examine the pointwise marginal effects of agricultural output. Hence, the study investigates the structural adjustments in the growth of agricultural output via empirical estimation employing the pointwise marginal effects.

Table 8: Pointwise Derivatives using KRLS

lnAO	Avg.	SE	T	P>|t|	P25	P50	P75
lnCA	0.168423	0.024666	6.828	0.000	0.094388	0.134766	0.239962
lnCP	0.275478	0.029175	9.442	0.000	0.140345	0.253149	0.464077
lnFRMT	0.069006	0.024971	2.763	0.009	-0.110624	0.040574	0.234998
INF	0.005312	0.005521	0.962	0.342	-0.011307	0.010264	0.030799
Diagnostics							
Lambda	0.1113	Sigma	4	R^2	0.9929	Obs	42
Tolerance	0.042	Eff.Df	14.76	Looloss	2.198		

Source: Computation from Stata 16.0

Table 8 shows the average pointwise marginal effects of cocoa farming financing, crops farming financing, foreign remittances and inflation rates on agricultural output alongside their standard errors, t statistics and p-values. At 5%, the estimation model indicated statistically significant with a predictive power of 0.9929, showing that the explained variables account for 99.3% changes in the agricultural output. Further investigation revealed heterogeneous marginal effects using derivatives of the explanatory is shown as P25, P50 and P75 percentiles in the Table 8. The estimation indicated presence of heterogeneous marginal effects in sampled variables, thereby authenticating the robustness of the pointwise derivatives. This implies that the mean average marginal effect of cocoa farming financing, crops farming financing, foreign remittances and inflation rates on agricultural output are 0.17, 0.28, 0.07 and 0.005 percent points, respectively.

By comparing the results of the conventional ARDL with that of KRLS, the KRLS results showed significant influence of cocoa farming financing, crops farming financing and foreign remittances on agricultural output while inflation rates were not, conventional ARDL in the long-run indicated no statistical significant except the inflation rates. The average marginal effect estimate is larger and shows that a percentage point rise in cocoa farming financing exerts a 0.17 percentage point increase in agricultural output on average. Mores so, crops farming financing has a significant and positive average marginal effect on agricultural output, showing that crops financing has a 0.28 percent point increase on agricultural output on average. Again, foreign remittances have significant and positive average marginal effect on agricultural output, implying a percent rise foreign remittances have a 0.07 percent point increase in agricultural output.

In summary, the improved model fit confirmed that the nexus among cocoa farming financing, crops farming financing and foreign remittances are not linear as indicated by the OLS model. Rather, the relationship is more of non-linear nexus and the KRLS fit appropriately learns the trend of the conditional expectation functional relationship of the data. These results conform to the Cobb-Douglas production function and Schumpeter theory of finance-led growth, which held that growth in agricultural output is a function of labour, capital, technological progress and finance. More so, the finding of this study confirmed the discovery of Yusuf, Adeniran and Adeagbo (2020), Odili (2022), Abbas (2021) and Abdulrafiu and Abigail (2022), while Oyakhilomen, Omadachi and Zibah (2012); and Kouadio, Anani, Faye and Fan (2023). It, however, contradicts the findings of Kouadio, Anani, Faye and Fan (2023) that found no significant nexus between the two variables in their studies. The results also is in line with the findings of Abu (2024), Golley and Samuel (2021), Akinuli and Osagiede (2023), Sule, Gana and Abdullahi (2023), etc who in their various studies found significant and positive nexus between the crops farming financing and agricultural output. However, the results contradict the discovery of Abdul et al. (2022), Anthony et al. (2020), Mohammed and Yogesh (2022) studies that found no significant relationship between the two variables. Similarly, The results also unveils on the average that a 1% rise in foreign remittances improves agricultural output by 0.0.07 percent point in Nigeria. This result also is in tandem with the Schumpeter theory of finance-led growth published in 1911, as it conceives financing including agricultural sector as a critical factor for agricultural output growth. Similarly, the result is also in conformity with the finding of Romanus, Ngozi and Tyrone (2020), James et al. (2020) and Falaye (2023) that discovered significant and positive relationship between remittances and agricultural output in the economies.

Table 9: Distribution of the Pointwise Marginal effects

sum d_lnao, detail; sum d_lnca, detail; sum d_lnfrmt, detail d_lnao; d_lncax; d_lnfrmt						
	Percentiles	Smallest				
1%	-0.1091517	-0.1091517				
5%	0.0092483	0.0071921				
10%	0.0622519	0.0092483	Obs	42		
25%	0.0943885	0.0101624	Sum of Wgt.	42		
50%	0.1347659		Mean	0.1684234	0.2754778	0.0690059
	Largest		Std. Dev.	0.1198317	0.2020186	0.2005646
75%	0.2399619	0.354848				
90%	0.3155212	0.4297621	Variance	0.0143596		
95%	0.4297621	0.438198	Skewness	0.5281054		
99%	0.4632278	0.4632278	Kurtosis	3.407511		

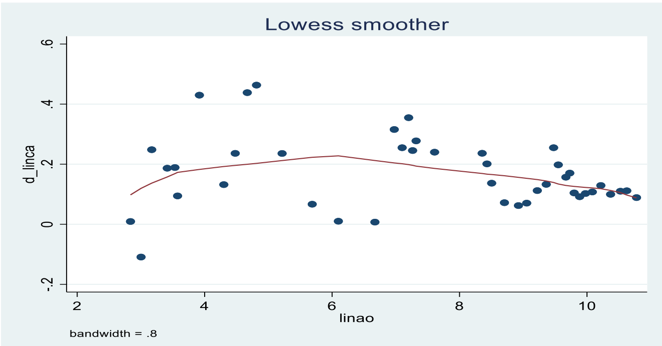
Source: Computation from Stata 16.0

Table 9 shows the results of average pointwise marginal effects of agricultural output. From the results, the estimation revealed that the average marginal effect of cocoa farming guaranteed funds is 0.0.17, crops farming funds is 0.3 and foreign remittances reported 0.07 which are equally the same with the quantities displayed in the KRLS Table 8 under the Avg. column for cocoa farming, crops farming and foreign remittances. These quantities are akin to the coefficient estimates from the linear regression and can be interpreted as the average marginal effects. The results clearly show the heterogeneity in the marginal effects. For example, at the 1st quartiles, a 1% increase in cocoa farming is associated with a 0.09 percentage point rise in average marginal effects of agricultural output, while at the 3rd quartiles, a 1% improve in crops farming credits exert a 0.13 percent rise in average marginal effects of agricultural output in Nigeria. The median of the average marginal effects of agricultural output is 0.24 percent rise.

Derivative of the Non-Linear Conditional Model

The result displayed in Figures 6 to 8 shows how the marginal effect estimates from KRLS accurately track the derivative of the non-linear conditional relationship in the regression model.

Lowess Smoother



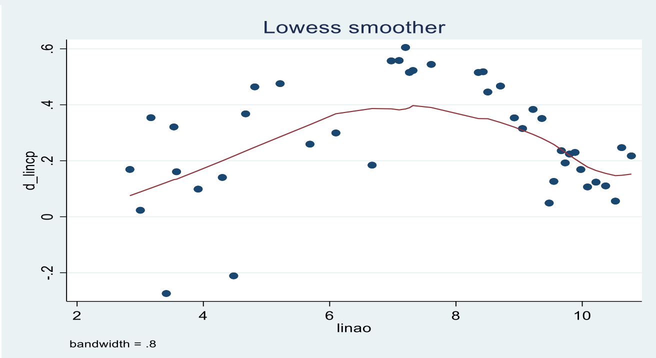


Figure 6: Pointwise marginal effect of lnCA on lnAO **Figure 7: Pointwise marginal effect of lnCP on lnAO**

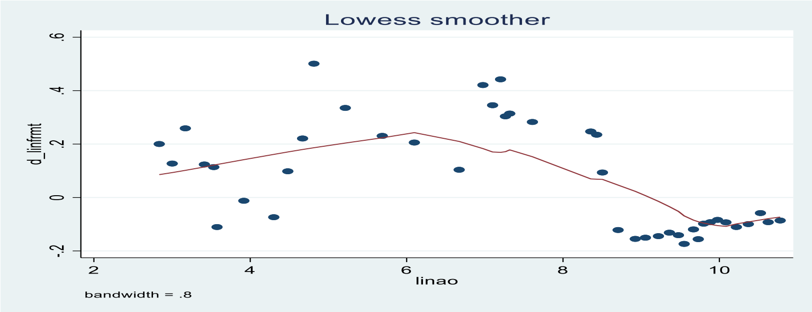


Figure 8: Pointwise marginal effect of SEX and GDP

Having shown the interpretive gains of KRLS, this estimation is undertaken to fit in a full model and thus, compares the results estimated through the ARDL with that KRLS in detail. As revealed in Figures 6 to 8, KRLS was able to provide a flexible fit, improving on both in- and out-of-sample accuracy.

V. Policy Implication Of The Results

From the KRLS model, the results showed that cocoa and crops farming financing and foreign remittances had significant and positive rising average marginal effects on agricultural output in Nigeria. By implication, 1% rise in cocoa farming financing, crops farming financing and foreign remittances will improve agricultural output by 0.17, 0.3 and 0.24 percentage points, respectively. These findings underscore the importance of employing KRLS technique in investigating the impact of agricultural financing on agricultural output. The results validated the Cobb-Douglas production function and Schumpeter theory of finance-led growth in Nigeria, and are line with the findings of Yusuf, Adeniran and Adeagbo (2020), Odili (2022), Abbas (2021) and Abdulrafiu and Abigail (2022).

Contribution to Knowledge in Literature

This study contributed to literature debate by comparing the conventional ARDL model which involves linear regression model with the KRLS model involving non-linear regression model in the estimation of agricultural financing components and agricultural output in Nigeria. In the study, agricultural output is modeled as function of cocoa farming financing, crops farming financing, foreign remittances and inflation rates. The results showed that cocoa farming financing, crops farming financing and foreign remittances were not significant in the conventional ARDL model but all the variables were found significant in the KRLS model. Hence, the study contributed to pool of knowledge in literature.

VI. Recommendations

1. Since the cocoa farming financing exerts a significant and positive influence on agricultural output in Nigeria, government should guarantee more sufficient funds on cocoa farming activities with adequate monitoring of the credit guaranteed to the sub-sector. By so doing, the commercial banks will devote more loans for cocoa production in the economy, and hence, boost cocoa agricultural output and promotes its exports in Nigeria.
2. Having shown that crops farming financing had a significant and positive average marginal impact on agricultural output, government should is advised to increase agricultural credit guaranteed on crops farming activities in Nigeria. It is in this view that the commercial banks will channel more credits for crops production within the economy, thereby leading to increase in agricultural output and hence, food security in Nigeria.
3. Since foreign remittances significantly and positively affected agricultural output in Nigeria, the study recommends that government should encourage more foreign personal remittance inflows in the economy by removing all policies that hinder inflows of personal remittances such as dispensing of local currency in exchange for foreign currency sent back to home country by migrants, and other obnoxious charges on foreign remittance inflows. In so doing, migrants will be encouraged to send more remittances to their relatives that will in turn, use same for farming activities and promote agricultural output in the economy.

VII. Conclusion

This study was undertaken with the aim of examining the impact of agricultural financing on the output of agricultural sector in Nigeria from 1981 to 2022. To find empirical results, ARDL model, dynamic ARDL model and KRLS model were deplored to estimate the variables of interest. The results showed evidence of long-run equilibrium relationship among the variables. The estimation from the KRLS model as boost disclosed that cocoa farming guaranteed funds, crops farming guaranteed funds and foreign personal remittances significantly and positively affected agricultural output in Nigeria. Having carried out this study with adequate method identification and arriving at policy recommendations, it is the belief of the research that if the aforementioned recommendations are diligently adhered to by the government; it will go a long way in ensuring improved agricultural output in Nigeria. It will also ensure food security, provides employment opportunities to teeming population, revenue to the poor farmers alongside improved agricultural exports that will lead to increase government revenue.