DOI: https://dx.doi.org/10.4314/gjass.v22i1.5

GLOBAL JOURNAL OF AGRICULTURAL SCIENCES VOL. 22, 2023: 37-46
COPYRIGHT© BACHUDO SCIENCE CO. LTD PRINTED IN NIGERIA ISSN 1596-2903
www.globaljournalseries.com.ng, Email: globaljournalseries@gmail.com

THE EFFECT OF AGRICULTURAL CREDIT ON CASSAVA OUTPUT AND YIELD IN NIGERIA.

TIMILEYIN VICTORIA ALABI, ADEGBOYEGA EYITAYO OGUNTADE AND REUBEN ADEOLU ALABI

(Received 16 June 2023; Revision Accepted 18 July 2023)

ABSTRACT

The broad objective of this study is the analysis of the long and short run effects of agricultural credit on cassava yield in Nigeria. The study applied descriptive statistics and autoregressive distributed lag (ARDL) econometric) approach to the secondary data collected from Central Bank of Nigeria Statistical Bulletin and FAOSTAT. The descriptive analysis shows that cassava output was increasing in Nigeria with decreasing trend in yield. It was revealed in the study that Roots and Tubers Expansion Programme (RTEP) has no significant effect on cassava production and yield. The result of the econometric analysis indicates that agricultural credit do not have significant long and short-run effects on cassava production and yield. This is because the real per capita agricultural credit is small. However, study indicates that fertilizer has long and short-run effects on cassava output but does not have a significant effect on cassava yield. This study also documented evidence of declined labour and land productivity on the long and short-run. The study reveals that ecessive rainfall can be detrimental to cassava production in the long and short-run. The study concludes that although, agricultural credit do not have significant long and short-run effects on cassava production and yield, it is positively correlated with agricultural inputs used in cassava production. The study recommended the need to address the decline in the real value of per capita credit by increasing the amount of credit given to the farmers. There is also the need to design more credit facilities suitable to the farmers. The current Anchor Borrowers programme should be designed to accommodate more resource-poor cassava farmers.

BACKGROUND INFORMATION

In order to encourage the agricultural and food production sector, the government over the years has put in place various policies and measures to boost food and agricultural production in Nigeria. Some of these programmes, projects and institutions are: Commodity and Marketing Board, National Accelerated Food Production Programme (NAFP), Operation Feed the Nation (OFN), National Seed Supply Services (NSS), Land Use Decree (LUD); Green Revolution (GR); National Agricultural Land Development Authority (NALDA), Agricultural Project Monitoring and Evaluation Unit (APMEU), Structural Adjustment Programme (SAP), the Presidential Initiative on cassava production and Agricultural Credit Guarantee Scheme Fund (ACGSF). ACGSF is one of the most sustained institutional agricultural credit schemes in Nigeria (Mafimisebi *et al.*, 2008; Onuselogu, 2014; Adetiloye, 2012; Nwosu *et al.*, 2010). The Scheme was established to provide guarantee on loans granted by banks to farmers for agricultural production and agro-allied processing (Nwosu *et al.,* 2010). The ACGSF is available to provide succor to banks that lend to farmers under the programme (Mafimisebi *et al.*, 2008). It was established to help farmers who have little or no collateral to get loans from commercial banks by Central Bank of Nigeria (CBN). It aimed at solving the problem of inadequate funding of farm operators by banks and to cushion these financial institutions against the effects of high risks associated with investments in farm enterprises as well as to raise the productivity and earnings from farm investments

Timileyin Victoria Alabi, Department of Agricultural and Resource Economics, Federal University of Technology, Akure, Ondo State, Nigeria
Adegboyega Eyitayo Oguntade, Department of Agricultural and Resource Economics, Federal University of Technology, Akure, Ondo State, Nigeria
Reuben Adeolu Alabi, Department of Agricultural and Resource Economics, Federal University of Technology, Akure, Ondo State, Nigeria

so that the incidence of loan repayment default among the farmers will be minimized.

As agriculture is important to the Nigerian economy so is the root and tuber (which are mainly cassava and yam) crops sector in Nigeria. Tuber and root crops, including cassava, yam, potato and sweet potato are the most important food crops for human consumption in Nigeria (IITA, 2015). These crops are cultivated in varied agro ecologies and production systems contributing to more than 240 million tonnes annually, covering up to 23 million hectares. The aggregate value of yam, cassava, potato and sweet potato surpasses all other staples grown in Nigeria (IITA, 2015). FAOSTAT (2019) demonstrated that that roots and tubers constitute about 49% of total crops produced in Nigeria between 1981 and 2017, while cereal, coarse grains, fruits and vegetable constitute about 17%, 14%, 7% and 7% respectively. Olomola *et al* (2015) revealed the relative importance of root and tuber crops when compared with cereals—the next-most-important crop category in Nigeria. They showed that the national production of root and tuber crops was nearly four times that of cereals. Sanginga (2015) revealed that the aggregate value of yam, cassava, potato and sweet potato which are root and tuber crops exceeds all other staple crops, and is much higher than the value of cereal crops in Nigeria. There are many compelling reasons for encouraging root and tuber crops for sustainable food production in Nigeria. They are versatile staples to address food and nutrition security for millions of people, and produce more food per unit area of land (IITA, 2012). Therefore, the cultivation of root and tuber crops is critical to food supply and food security in Nigeria.

Problem Statement

The importance of tuber crops, especially cassava and yam, in ameliorating food insecurity has been highlighted by Food and Agriculture Organization (CGIAR, 1997). Cassava and yam are capable in efficiently converting natural resources into a more usable product, caloric energy which is the highest of all major arable crops; almost double that of wheat and rice. Cassava and yam contribute to a more stable food system and predictable source of income (IITA, 2012). However, tuber crops like cassava and yams are experiencing declining productivity trend (IITA, 2012; FAOSTAT, 2019). The declining yield of cassava and yam needs to be addressed urgently because of their importance in reducing food insecurity. According to Mignouna *et al* (2015) efforts to boost cassava and yam yields are likely to be more sustainable and have a greater impact on food security than other crops. Agricultural credit is one of the vehicles to improve agricultural productivity in Nigeria (Onuselogu, 2014). This is because, it will not only relax the capital constraints on the farm, it may also increase the ability of the farmers to adopt agricultural technologies and mechanization that can improve agricultural yields (Awotide *et al*, 2015). Therefore, the study is aimed at analyzing the effects of agricultural credit on cassava yield in Nigeria. Specifically, the study estimated the long and short run effects of agricultural credit on cassava output and yield in Nigeria.

Study Area and Data Collection

This area of study is Nigeria. Nigeria is located on the Gulf of Guinea in West Africa. Nigeria occupies an area of 923, 789 square kilometers and is bordered on the East by Republic of Cameroon, on the West by the Republic of Benin and on the North by Niger Republic. More than 70% of the population who reside in rural areas depend on agriculture as a means of livelihood (FAO, 2022). Yam and Cassava are grown all over the country but mostly grown in Benue (known as the food basket of the nation), other state includes; Cross River, Adamawa, Delta, Ekiti, Imo, Edo, Kaduna, Ogun, Kwara, Ondo, Osun, Plateau and Oyo (Adetiloye, 2012).

Data for this study were collected mainly from secondary sources. Agricultural credit (million Naira), average rainfall (millimeters) data were extracted from Central Bank of Nigeria (CBN) Statistical Bulletin. Cassava Output and yield, Farm labour (modelled as the ratio of farmers' population to rural population in Nigeria), farmers population, rural population, fertilizer, arable land per farmer and temperature were extracted from FAOSTAT website (FAOSTAT, 2023). All monetary values were deflated (GDP deflator) (obtainable from CBN Statistical Bulletin) using 2010 constant prices to exclude the influence of inflation, other temporary monetary and fiscal trends. The data range from 1981 to 2021. Summary Statistics of all the variables used in the study are presented in Appendix 1.

Data Analysis Techniques

Descriptive statistics were applied on the relevant data collected for this study. The descriptive statistics applied include mean estimation and growth trend analysis. The growth rates of cassava output and yield were estimated following the procedure of Barrett (2001). For example, the growth rate of cassava output was estimated using equation 1 as:

$$\log(\text{Cassava}_t) = \alpha_o + \psi_1(\text{Year}) + \ell_{pt} \quad \text{- - - (1)}$$

Where log is the logarithm in base 10, Year is the period under consideration, where 1981 stands for 1 and 1982 stands for 2 and 41 represents 2021. The Cassava_t is cassava output in each of the corresponding year, the error term is ℓ_{pt}, ψ_1 is the estimated cassava output growth rate when expressed in percentage.

Autoregressive distributed lag (ARDL) methodology was applied to relevant data collected for this study in measuring the long and short run effects of Agricultural credit on cassava production and yield. The first step in applying ARDL is the bounds test for the null hypothesis of no cointegration. Following the step of Udoh (2011), the null hypothesis of co-integration among the dependent variable and explanatory variables can be tested in equation 2 below.

$$CAS_t = c_0 + c_1 logCAS_{t-k} + c_2 logRAF_{t-k} + c_3 logTEM_{t-k} + c_4 logLAN_{t-k} + c_5 logLAB_{t-k} + c_6 logCRE_{t-k} + c_7 logFER_{t-k} + \sum_{k=1}^{q1} a_1 \Delta logCAS_{t-k} + \sum_{k=1}^{p1} a_2 \Delta logRAF_{t-k} + \sum_{k=1}^{q2} a_3 \Delta logTEM_{t-k} + \sum_{k=1}^{q3} a_4 \Delta logLAN_{t-k} + \sum_{k=1}^{q4} a_5 \Delta logLAB_{t-k} + \sum_{k=1}^{q5} a_6 \Delta logAGRE_{t-k} + \sum_{k=1}^{q6} a_7 \Delta logFER_{t-k} + \epsilon_t \quad \text{- - - (2)}$$

Equations (2) assumes that Cassava yield (CAS) is determined by Rainfall (RAF), Temperature(TEM), land(LAN), farm labour (LAB), agricultural credit(CRE) and fertilizer (FER). Where p and q are the lag lengths of dependent and independent variables respectively. The long run elasticities are the c_s, and a_s are the short run elasticities. Δ is the differencing factor and ϵ_t is the error term, log is logarithm in base 10. The null and alternative hypotheses for equation 2 can be stated as:

H_0: $c_1 = c_2 = c_3 = c_4 = c_5 = c_6 = c_7 = 0$ (no long run relationship among the variables)

H_1: $c_1 \neq c_2 \neq c_3 \neq c_4 \neq c_5 \neq c_6 \neq c_7 \neq 0$ (there is long run relationship among the variables)

After estimating equation 2, the bounds testing was done by testing H_0 against H_1, the calculated F and t-statistics were then assessed against the critical values and approximate probability values given by Kripfganz and Schneider (2018) for small sample size estimation. The lower bound critical values assume that the explanatory variables are integrated of order zero, that is 1(0), while the upper critical values assumed that the explanatory variables are integrated of order one, that is 1(1). If the calculated F and T values are lower than the lower bounds, the null hypothesis is accepted. If they are greater than the lower bounds but less than the upper bounds, the decision is inconclusive. Finally, if the F and T values are greater than the upper bounds, the null hypothesis of no cointegration is rejected in favour of existence of a long-run relationship among the variables. Once the existence of a long run co-integration relationship is confirmed, the conditional ARDL (p1, q1, q2, q3, q4, q5, q6) long run equation for cassava yield model can be estimated as:

$$logCAS_t = \beta_0 + \beta_1 logCAS_{t-k} + \beta_2 logRAF_{t-k} + \beta_3 logTEM_{t-k} + \beta_4 logLAN_{t-k} + \beta_5 logLAB_{t-k} + \beta_6 logCRE_{t-k} + \beta_6 logFER_{t-k} + \epsilon_t \quad \text{- - - (3)}$$

The short run dynamic estimates can be obtained by estimating an error correction model associated with the long run parameters from equation 4 as:

$$\Delta logCAS_t = \delta_0 + \sum_{k=1}^{q1} \delta_1 \Delta logCAS_{t-k} + \sum_{k=1}^{p1} \delta_2 \Delta logRAF_{t-k} + \sum_{k=1}^{q2} \delta_3 \Delta logTEM_{t-k} + \sum_{k=1}^{q3} \delta_4 \Delta logLAN_{t-k} + \sum_{k=1}^{q4} \delta_5 \Delta logLAB_{t-k} + \sum_{k=1}^{q5} \delta_6 \Delta logCRE_{t-k} + \sum_{k=1}^{q6} \delta_7 \Delta logFER_{t-k} + \theta ECT_{t-1} + \epsilon_t \quad \text{- - - (4)}$$

Where ECT is the error correction term, θ is the speed of adjustment to equilibrium, β_s and δ_s are the long and short run elasticities that measure the effect of agricultural credit and other explanatory variables on cassava yield. Other variables are as previously defined.

In pressing further with ARDL analysis, we performed Augmented Dickey – Fuller test (ADF) test to check for unit roots in order to be sure that none of the variables are in the integration order greater than one. Augmented Dickey-Fuller test shows that all the variables of interest were stationary after they were differenced, except temperature, labour and rainfall variables, which are stationary at levels. This means that all the variables are integrated of order one I(1), while temperature, labour and rainfall variables are of I(0). This is reported in Appendix 2. The relevant optimal lag lengths were also determined by Schwarz Information Criteria (SBIC) indicated in Appendix 3.

Result and Discussion of Cassava Production and Yield Trend

Table 1 reveals that cassava output has increased from minimum of 10 million tonnes to 65 million tonnes between 1981 and 2021. The fact remains that the increase in cassava output is due to expansion of land put under cassava cultivation as the land under cassava cultivation increased from the minimum of 1060 hectares to 9780 hectares during the period under consideration. This became clearer as the table shows that cassava out and land expansion grew almost at the same rate (cassava and land cultivation under cassava grew at 4.50% and 5.08% respectively). This may explain why the cassava yield growth rate stood at -0.58%. FAO (2018) has indicated that increase in agricultural output in Nigeria comes mainly from increase in land expansion rather than through productivity gain.

The table also indicates that the mean agricultural credit is 1.01 billion Naira which ranges from 0.23 to 4.60 billion Naira. It grew by about 23% within the years under consideration. Whether this positive growth in agricultural credit will have impact on cassava output or yield or not depends on how much this credit goes into cassava production activities.

Table 1: Growth in Cassava Output, Cassava Yield and Agricultural Credit in Nigeria

Variable	Mean	Standard Deviation	Minimum	Maximum	Growth Rate (%)
Cassava Output (Million tonnes)	35.60	16.50	10.00	65.00	4.50
Cassava Yield (Tonnes/Ha)	9.99	1.56	5.82	12.22	-0.58
Cassava Land Area(Hectares)	3817.32	2331.12	1060.00	9780.00	5.08
Credit (Million Naira)	1011.82	1332.58	0.23	4600.00	23.08

Source: Computed by the Authors

Table 2 shows that roots and tubers crop category in which cassava has the largest share in term of the amount and value has been given share of the of Agricultural Guarantee Credit Scheme Fund (AGCSF) that is less than their contribution to food crop sector. The tables reveals that grains received almost four time (357%) of its contribution to food crop sector, root and tuber received less than hundred percent(99%) of their contribution to food crop sector. If cassava production is not accorded the right priority in credit allocation, it may limit the impact of the credit on cassava output and yield. Other authors have also reported the negligence of roots and tubers in terms of financing and development in Nigeria (IITA, 2012; Sanginga, 2015).

Table 2: Share of Root and Tubers in Food Crops Sector and ACGSF Credit (1981-2021)

Food Crops	Share in ACGSF Credit	Share in Food Crops Sector	Agriculture Orientation Index(AOI)
Grains	50.88	14.24	3.57
Roots and Tubers	48.34	48.80	0.99
Beans and Soya	0.25	1.67	0.15
Vegetables	0.54	6.82	0.08

Source: Computed from CBN (2021) and FAOSTAT (2023)

Another factor that may affect the impact of agricultural credit on cassava production is the amount credit received per farmers. The lower the amount the lower may be the expected impact on cassava output and yield. Table 3 demonstrates that per capita agricultural credit has increased on the average from N5754 to N158914, the real value of per capita credit has declined from N15241 in 1981 to N1056.The implication of that is that farmers could only buy about 7% of what they were able to buy in 1981 in 2021(N1056/ N15241) with the given credit. The study has also indicates that per capita credit for farmers has declined from 1937 USD in 1981 to 735 USD in 2021 as presented in Table 3. For farmers that depend on imported farms equipment and agro-chemical, this also means they could only buy 38% (735/1937) in 2021 of farms equipment and agro-chemical they purchased in 1991 with the agricultural credit they secured. This may partly explain the reason for low level of agricultural mechanisation in Nigeria. For example, while other developing countries have 130 tractors/100km^2, Nigeria has seven (7) tractors/100km^2 compared with Sub Sahara Africa (SSA) and World averages of 13 tractors/100km^2 and 200 tractors/100km^2 of arable land respectively (WDI, 2019). This implies that Nigerian farmers have low accessibility to means of agricultural mechanization that can increase their productivity. Oyakhilomen and Rekwot (2014) have also alluded to the negative effect of inflation on agricultural sector, because it reduces the purchasing power of the farmers. They recommended that the Central Bank of Nigeria should pay more attention to the trend of inflation and pursue policies that will ensure single digit inflation.

Table 3: Average Per capita Agricultural Credit in Naira and US Dollars (USD) (1981-2021)

Period	Amount ('000)	Per capita (Naira)	Real Per Capita (Naira)	Per capita (USD)
1981-1990	68959	5754	15241	1937
1991-2000	181048	10488	828	373
2001-2010	4533025	101713	1550	767
2011-2021	7654015	158914	1056	735
	3220109	73509	4581	465

Source: Computed by the Authors

The Effect of Agricultural Credit on Cassava Output and Yield

The result of the estimation of the long and short run effects of agricultural credit on cassava output is presented in Table 3. The maximum length selection was done based on SBIC and presented in Appendix 3. SBIC supports selection of maximum lag length of one (1) year. The optimal lag length structure selected for each of the variable and is reported in Appendix 4. The appendix 4 suggests that the optimal lag length structure is 1,1,0,1,1,0,1. This implies that cassava output, rainfall, temperature and labour will be lagged one (1) year, while the current forms of other variables such as agricultural credit, arable land and fertilizer will be used in the estimation of the model.

Table 4 reveals that the estimated F value of 260.76 is significant at 1% level of significance. This is an attestation to the fact that the cassava output and agricultural credit model estimated in Table 3 is a good fit and therefore the model can be interpreted to represent the economic relationship among the variables specified in the table. The estimated adjusted R^2 of 0.9856 suggests that the explanatory variables specified in Table 3 can explain 99% variation in cassava output.

Table 4 reveals that the significant determinants of cassava output on the long run are past cassava output, annual rainfall, past and current arable land, past and current labour and fertilizer. The importance of past output in stimulating current output has been associated with income opportunity generated in the past production, which can be reinvested in the current production activity. The volume of the past cassava output can be an indication of past farmers' experiences which can enable the farmers to avoid the negative past agricultural production decision and adopt the best farming practices. The coefficient of lagged rainfall is significant but negative because excessive rainfall can be detrimental to cassava production. The negative effect of last year (2022) flood in Nigeria was a clear evidence of the detrimental effect of excessive rainfall on agricultural production (Reed *et al*, 2022). Flood can hinder some farmers from planting and harvesting their crops. Land is the factory where agricultural production takes place, hence the positive and significant coefficient of arable land in Table 3. In the same token, a degraded land can be less productive. This may explain the negative coefficient of the lagged land because it will take current serious efforts to improve unfertile and degraded land. Philip *et al* (2019) has also reported unproductivity of Nigerian land because of shortened fallow period and little investment on the farm to restore land fertility. Table 4 also reports a positive and significant coefficient of current labour variable in the model. This is because agriculture activity cannot take place in forms of cultivation of land, planting and harvesting without labour. However, labour may be less productive if the farmers are sickly and too old to farm productively. This may be account for the negative coefficient of the lagged labour variable in the model. Other scholars have reported unproductivity of farm labour in Nigeria (Wisdom, 2016; Angaye, 2016). If the low agricultural labour productivity is not addressed it can lead to labour migration from rural area to urban area and diversification from agricultural sector to non-farming enterprises (Sackey, *et al,* 2012; Takeshima, *et al*, 2018). Fertilizer coefficient is positive and significant as expressed in Table 4. This is because fertilizer is important in increasing land productivity (Jaja and Barber, 2017). The table also shows that agricultural credit is positively related with cassava output but not significant even at 10% level of significance. This may be due to low-level of agricultural credit flow to agriculture from ACGSF (Olowofeso *et al*, 2017). Nwakanma *et al* (2014) has also indicated a positive but non-significant long-run relationship between agricultural output and credit in Nigeria. Evidence suggests that the financing gap for smallholder farmers in Nigeria is huge (AfDB, 2016). The reason for non-significance of agricultural credit can be attributed to the fact that majority of the farmers are financially excluded (Alabi *et al*, 2020). Evidence shows that majority of the farmers relied on informal credit sources with smaller amount of loans that is too little to significantly increase their production (Awotide *et al*, 2015). Awotide *et al* (2015) reported that agricultural credit may not affect agricultural production and productivity directly but the indirect effect may reflect on the ability of agricultural credit to influence adoption of farm investment that may increase farm productivity. However, we put agricultural credit in the estimated equation to check if agricultural credit will behave differently from the hypothesis of Awotide *et al* (2015).

In Table 4, the error correction term of -0.3037 is significant at 1% level of significance. This confirms a joint significant relationship among the variables estimated in Table 3. The fact that the value is -0.3037 implies that about 30% of dis-equilibrium to the long run relationship in the model can be reverted within a year. In addition, the short run model of cassava output and agricultural credit presented in Table 4 reveals that arable land, labour and fertilizer have short significant effects on cassava output in Nigeria.

Table 4: Estimates of the long and short run coefficients of the ARDL model (Effect of Agricultural Credit on Cassava Output)

	Long Run			Short Run	
	F	260.76			
	Prob > F	0.0000			
	R^2	0.9894		R^2	0.6216
	Adj R^2	0.9856		Adj R^2	0.4865
Variables	Coefficient	P>|t|	Variables	Coefficient	P>|t|
Cassava Output(-1)	0.6963***	0.000	∆Rainfall	-0.1280	0.395
Rainfall	-0.1280	0.395	∆Temperature	-0.0010	0.980
Rainfall(-1)	-0.3377**	0.025	∆Arable Land	18.9933***	0.002
Temperature	-0.0010	0.980	∆Labour	17.9221***	0.003
Arable Land	18.9932***	0.002	∆Agric credit	-0.0026	0.889
Arable Land(-1)	-17.9031****	0.002	∆Fertilizer	0.1022***	0.002
Labour	17.9221***	0.003	ECT	-0.3037***	0.009
Labour(-1)	-17.3187***	0.003			
Agric Credit	-0.0026	0.889			
Fertilizer	0.1022***	0.002			
Constant	-14.6100	0.239			
Log likelihood	58.1923				

(*), (**) and (***) expresses 10%, 5% and 1% significance level respectively, ∆ = differencing factor. (-1) represents lag length of one (1) year

Source: Computed by the Authors

In estimating the effect of agricultural credit on cassava yield in Table 5, maximum lag length for the cassava yield and agricultural credit model was determined and presented in Appendix 5. SBIC criterion supports maximum lag selection of one (1) as presented in Appendix 5. The optimal lag length structure for each of the variable in the model was also determined. Appendix 4 shows that the optimal lag length structure for the model is 1,0,1,0,0,0,0. Suggesting that cassava yield and arable land should be lagged one (1) year, while the current values of rainfall, temperature, labour, agricultural credit and fertilizer were used in the estimation. The cointegration of relationship among the variables was tested using Bound test and presented in Appendix 6. Since the calculated F and T values of 3.833 and -4.563 respectively are greater than the theoretical value of F and T of 3.665 and -4.017 (in absolute terms) respectively, the alternative hypothesis of cointegration among the variables is accepted. This means that long and short runs relationship among the variables can be estimated. Table 5 presents ECT of -0.7085, which is significance at 1% level of significance. The significance of ECT is a confirmation of joint significance of the variables in the model.

Table 5 reveals that the estimated F value of 7.22 is significant at 1% level of significance. This is an evidence to show that the model estimated in Table 5 is a good fit and can be used to represent the economic relationship between cassava yield, agricultural credit and other explanatory variables such, past cassava yield, rainfall, temperature, arable land, labour and fertilizer. The adjusted R^2 of 0.5670 indicates that about 57% of variation in cassava yield can be explained by the explanatory variables stated in Table 5. The table reveals that past cassava yield has positive and significant effect on the current cassava yield. The positive effect of past agricultural activities on the current activities has been explained to be due to the backward integration of income received from the past agricultural production into the current production. Therefore, as expected the past cassava yield has positive and significant coefficient on the current cassava yield. As in cassava production, excessive rainfall can affect cassava yield as cassava need moderate rainfall for optimal performance. This may explain the negative rainfall coefficient as it relates to cassava yield presented in Table 5. The table also shows that past temperature is a positive and significant determinant of cassava yield. This is expected as cassava needs adequate temperature with associated sunshine for improved performance. Akinwumiju, *et al* (2020) have indicated that the highest production cassava is expected in the tropics, with temperature and annual rainfall amount ranges of 25–27 °C and 1200–1500 mm, respectively. They have proved through greenhouse and on-farm experiments that cassava has a wider tolerance range for temperature (15–35 °C) and rainfall (500–5000 mm). The coefficient of labour is significant but negative. This is an indication of less productivity of labour. Other authors that have reported unproductivity of farm labour in Nigeria include Wisdom (2016) and Angaye (2016). The unproductivity of agricultural labour has been adduced for urban-rural migration and disinvestment in agricultural sector (Sackey, *et al,* 2012; Takeshima, *et al,* 2018). The table also reports a non-significance of agricultural credit because the farmers are disadvantaged in accessing agricultural credit because of the nature of farming and their locations that may lead to their financial exclusion.

Table 5 also demonstrates that on the short run, rainfall land and labour have significant but negative relationship with cassava yield. It has been explained that excessive rainfall may have detrimental effect on cassava output and yield. The negative but significant coefficients of land and labour have been explained on the account of declined land and labour productivities being witnessed in agricultural sector in Nigeria.

Table 5: Estimates of the long and short run coefficients of the ARDL model (Effect of Agricultural Credit on Cassava Yield)

	Long Run			Short Run	
	F	7.22			
	Prob > F	0.0000		Prob > F	0.0000
	R^2	0.6581		R^2	0.4726
	Adj R^2	0.5670		Adj R^2	0.3320
Variables	Coefficient	P>|t|	Variables	Coefficient	P>|t|
Cassava Yield(-1)	0.2915*	0.070	∆Rainfall	-0.4219*	0.079
Rainfall	-0.4219*	0.079	∆Temperature	0.0578	0.366
Temperature	0.0578	0.366	∆Arable Land	-0..9930**	0.025
Temperature(-1)	0.1269**	0.046	∆Labour	-1.3335***	0.012
Arable Land	-0.9931**	0.025	∆Agric Credit	0.0305	0.294
Labour	-1.3335***	0.012	∆Fertilizer	-0.0410	0.413
Agric Credit	0.0305	0.294	Constant	42.8945***	0.003
Fertilizer	-0.04103	0.413	ECT	-0.7085***	0.000
Constant	42.8945***	0.003			
Log likelihood	36.3203				

(*), (**) and (***) expresses 10%, 5% and 1% significance level respectively, ∆ = differencing factor.
Source: Computed by the Authors

CONCLUSION AND RECOMMENDATIONS

It is evident from the study that agricultural credit does not have significant long and short run effects on cassava production and yield. The reason for the non-significance of agricultural credit has been attributed to many factors in the study. In addition, the study submitted that fertilizer is a positive determinant of cassava production on the long and short run but not on the cassava yield. The declined in real value of per capita credit can be addressed by increasing the amount of credit given to the farmers. There is also the need to design more credit facilities suitable farmers. The current Anchor Borrowers programme should be designed to capture more resource poor cassava farmers. The farmers should be encouraged to reinvest the profits they made from cassava farming back into cassava production. This will help farmers reap the full benefits of their investment in cassava production.

REFERENCES

Adetiloye, K. A., 2012. Agricultural financing in Nigeria: An assessment of the Agricultural Credit Guarantee Scheme Fund (ACGSF) for food security in Nigeria. Journal of Economics, 3(1):39-48

AfDB, 2016. 2015-2019 Draft agriculture and agribusiness strategy. African Development Bank, Tunis, Tunisia.

Akinwumiju, A.S., Adelodun, A.A. and O.I Orimoogunje, 2020. Agro-Climato-Edaphic Zonation of Nigeria for a Cassava Cultivar using GIS-Based Analysis of Data from 1961 to 2017. Science Report 10, 1259 2020. https://doi.org/10.1038/s41598-020-58280-4

Alabi, R.A, Bakare, A and Alabi, T.V., 2021. Financial Inclusion, Innovation and Agricultural Develo pment inNigeria. In Tobias Knedlik (eds). Afri can Development Perspectives Yearbook. pa ge223_272. Institute of World Economics an d International Management, University of Br emen, Bremen, Germany.

Angaye, S.G., 2016. Nigeria and Africa Development. Port Harcourt, Nigeria: Pearl Publishers International Ltd.

Awotide, B. A, Abdoulaye, T, Alene, A and V.M, Manyong (2015). Impact of access to credit on agricultural productivity: Evidence from smallholder cassava farmers in Nigeria. A contributed paper prepared for oral presentation at the International Conference of Agricultural Economists (ICAE) Milan, Italy August 9-14, 2015.

Barrett, C. B., 2001. Does food aid stabilize food availability? Economic Development and Cultural Change 49 (2): 335-349.

CGIAR, 1997. Report of the inter center review of root and tuber crops research. Consultative Group on International Agricultural Research Technical Advisory Committee. FAO, Italy, Rome. Also available at https://cgspace.cgiar.org/handle/10947/1205

FAO, 2022. FAOSTAT database. Available at: http://bit.ly/NmQzZf.

FAO, 2018. Guidelines for the measurement of productivity and efficiency in agriculture. Food and Agriculture Organization Economic and Social Development Paper no. 16. Food and Agriculture Organization Publication: Italy, Rome.

FAOSTAT, 2023. Crops and Livestock Products. Ava ilable at https://www.fao.org/faostat/en/#data/QCL

FAOSTAT, 2019. Food and Agriculture Organization (FAO) of the United Nations, Rome, Italy. Available at: http://www.fao.org/faostat/en/#data/QC

IFAD, 2010. Nigeria: Roots and Tuber Expansion Programme (RTEP). Project Completion Digests. International Fund for Agricultural Development (IFAD), Rome.

IITA, 2012. Yam improvement for income and food security in West Africa. Available at http://www.iita.org/iita-project/yifswa-ii/

IITA, 2015. Root and Tuber Crops (Cassava, Yam, Potato and Sweet Potato). United Nations Economic Commission for Africa.

Jaja, E.T and L.I. Barber, 2017. Organic and Inorganic Fertilizers in Food Production System in Nigeria. Journal of Biology, Agriculture and Healthcare, Vol.7 (18): 51-55

Kripfganz, S., and D. C. Schneider, 2018. ARDL: Estimating autoregressive distributed lag and equilibrium correction models. Proceedings of the 2018 London Stata Conference. London, U.K

Mafimisebi, T. E, A. E Oguntade and O. E. Mafimisebi, 2008. A perspective on partial credit guarantee schemes in developing countries: The case of the Nigerian agricultural credit guarantee scheme fund (ACGSF). A Paper presented at a World Bank Conference at Washington, D.C from March 13-14, 2008.

Nwakanma, P. C., Nnamdi, I. S. and G.O Omojefe, 2014. Bank Credits to the Private Sector: Potency and Relevance in Nigeria's Economic Growth Process. Accounting and Finance Research, Vol. 3, No. 2, Pp. 23-35

Nwosu, F.O., Oguoma, N.N., Ben-Chendo, N.G., and A. Henri-Ukoha, 2010. The agricultural credit guarantee scheme Fund: Its roles, problems and prospects in Nigeria's quest for agricultural development. Researcher, Vol. 2, pp. 87-90.

Olomola, A., Mogues, T., Olofinbiyi, T., Nwoko, C., Udoh, E., Alabi, Reuben Adeolu., Onu, J and S Woldeyohannes (2015). Agriculture public expenditure review at the federal and subnational levels in Nigeria (2008-12). The World Bank, Washington, D.C, USA.

Olowofeso, O.E., Adeyemi A. A, Valli T. A, Kufre J. B and O, Abraham, 2017. Agricultural Sector Credit and Output Relationship in Nigeria: Evidence from Nonlinear ARDL. CBN Journal of Applied Statistics Vol. 8 (1):101-122.

Onuselogu O., 2014. Impact of Agricultural Credit Guarantee Scheme fund on agricultural production in Nigeria, 1978-2011. M. Sc. Thesis Department of Faculty of Business Administration Univ. of Nigeria, Enugu

Campus.Oyakhilomen O. and G.Z. Rekwot, 2014. The Relationships of Inflationary Trend, Agricultural Productivity and Economic Growth in Nigeria. CBN Journal of Applied Statistics Vol. 5 (1):35-47.

Philip, D. Nkonya, E. Pender, J and O. A, Oni, 2019. Constraints to increasing agricultural productivity in Nigeria: A Review. NSSP Background Paper 6. IFPRI, Washington, D.C.

Reed, C., Andersonb, W., Kruczkiewicz, A , Nakamurag, J, Galloh,D , Seagerg, R, and S.S. McDermid, 2022. The impact of flooding on food security across Africa. The Proceedings of the National Academy of Sciences (PNAS) 2022 Vol. 119 No. 43. https://doi.org/10.1073/pnas.2119399119

Sackey, I. Liverpool-Tasie; S,Salau, S and T. Awoyemi, 2012. Rural-Urban Transformation in Nigeria. Journal of African Development, 14 (2): 131–168.

Sanginga, N., 2015. Root and tuber crops. Available on the internet at https://www.afdb.org/fileadmin/uploads/afdb/Documents/Events/DakAgri2015/Root_and_Tuber_Crops__Cassava__Yam__Potato_and_Sweet_Potato_.pdf

Takeshima, Hiroyuki; Amare, Mulubrhan; and G,Mavrotas (2018). The role of agricultural productivity in non-farm activities in Nigeria: Effects on sector orientation and factor intensity. IFPRI Discussion Paper 1761. Washington, DC: International Food Policy Research Institute (IFPRI). http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/132867

Udoh, E., 2011. An Examination of Public Expenditure, Private Investment and Agricultural Sector Growth in Nigeria: Bounds Testing Approach. International Journal of Business and Social Science, 2(13), 285-291.

WDI, 2019. World Bank World Development Indicators Database. Available at http://data.worldbank.org/ datacatalog/world-development-indicators

Wisdom, S.K., 2016. Determinants of Agricultural Labour Productivity in Nigeria's South-South Geopolitical Zone. International Journal of Social Science and Humanities Research, Vol. 4, (4): 149-156.

Appendix 1: Summary Statistics of the Variables Used in the Study

Variable	Mean	Standard Deviation	Minimum	Maximum	Unit
Cassava Output	3.57e+07	1.65e+07	9950000	6.54e+07	tonnes
Cassava Yield	9991.812	1555.393	5827.1	12215.5	Tonnes/ha
Arable Land per farmer	0.3915355	0.0573271	0.1647975	0.4492944	Hectares
Farmers Population	1.24e+07	90198.93	1.23e+07	1.26e+07	Number
Labour	3.29e+07	8135515	2.77e+07	7.61e+07	Number
Rural Population	79673.74	12859.42	58369.9	99916.58	Number
General Population	133052.4	41471.45	75175.39	213401.3	Number
Annual Rainfall	1085.618	90.73856	864.28	1290.58	Millimetres
Annual Temperature	27.00171	0.3611919	26.25	27.76	Centigrade
Agric Credit	1.72e+07	9.00e+07	24654.9	5.79e+08	Naira
Fertilizer	184741.8	103182.7	70115	453000	Tonnes

Source: Computed by the Authors

Appendix 2: Augmented Dickey-Fuller (ADF) test for unit root

	At Level		After Differencing		
Variables	Test Statistics	Critical Value at 5%	Test Statistics	Critical Value at 5%	Remark
Log Cassava Output	-1.590	-2.961	-6.276	-2.964	I(1)
Log Cassava Yield	-2.558	-2.961	-7.411	-2.964	I(1)
Log Arable Land	-4.487	-2.961	-4.642	-2.964	I(1)
Log Arable land per Farmer	-2.885	-2.961	-4.741	-2.964	I(1)
Log Temperature	-4.219	-2.961	-9.011	-2.964	I(0)
Log Rainfall	-6.186	-2.964	-10.237	-2.961	I(0)
Log of Labour	-2.807	-2.961	-4.671	-2.964	I(0)
Log ACGSF(total for Agriculture)	-1.096	-2.961	-5.579	-2.964	I(1)
Log ACGSF(total for root and tubers)	-1.386	-2.961	-9.148	-2.964	I(1)
Log Fertilizer	-2.168	-2.961	-9.354	-2.964	I(1)

Source: Computed by the Authors

Appendix 3: Lag Length Selection-order criteria based on AIC, HQIC and SBIC in Cassava Output and Agricultural Credit Model

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	32.5184		1		.014256	-1.41769	-1.31022	-1.10978
1	48.8819	32.727*	1	0.000	.006087*	-2.27122*	-2.1484*	-1.91932*
2	48.9494	0.13503	1	0.713	.006432	-2.21941	-2.08124	-1.82353
3	49.0027	0.10645	1	0.744	.006808	-2.16681	-2.01329	-1.72695
4	49.0078	0.01028	1	0.919	.007232	-2.11154	-1.94267	-1.62769

(*), (**) and (***) expresses 10%, 5% and 1% significance level respectively
Source: Computed by the Authors

Appendix 4: Maximum Lag Length Selection Matrix based on SBIC for each of the Variables in the Equations

Dependent Variables	Lagged Dependent Variable	Rainfall	Arable Land	Temperature	Labour Intensity	CRE	Fertilizer
Cassava Output	1	1	0	1	1	0	0
Cassava Yield	1	0	1	0	0	0	0

Source: Computed Authors' computation printout

Appendix 5: Lag Length Selection-order criteria based on AIC, HQIC and SBIC in Cassava Yield and Agricultural Credit Model

Lag	LL	LR	df	p	FPE	AIC	HQIC	SBIC
0	28.05		1		.018273	-1.16944	-1.06198	-.861537
1	31.0514	6.0028*	1	0.014	.016392*	-1.28063*	-1.06198	-.92874*
2	31.1572	.21153	1	0.646	.017283	-1.23095	-1.09278	-.835074
3	32.81	3.3058	1	0.069	.016737	-1.26722	-1.1137	-.827358
4	32.9236	.22703	1	0.634	.017673	-1.21798	-1.1137	-.734122

(*), (**) and (***) expresses 10%, 5% and 1% significance level respectively
Source: Computed by the Authors

Appendix 6: Bounds test for Cointegration in the Cassava Yield and Agricultural Credit Model

	10% 1(0)	10% 1(1)	5% 1(0)	5% 1(1)	1% 1(0)	1% 1(1)	p-Value 1(0)	p-Value 1(1)	Critical Value
F	2.390	3.665	2.870	4.311	4.023	5.849	0.013	0.084	3.833
T	-2.534	-4.017	-2.892	-4.454 |	-3.626	-5.347	0.001	0.042	-4.563

Source: Computed by the Authors