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Agricultural Financing, Food Production and Poverty Reduction in Nigeria: Evidence from ARDL Model (Note 1)

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Abstract

The need for adequate food production in Nigeria is increasingly becoming a must-achieved objective for policy makers and government agencies owing to continuous rise of food prices. Notwithstanding this, food production requires adequate financing and by extension, plays some important role in reducing poverty level. Hence, this study investigates the extent to which specific agricultural financing will impact food production and reduce poverty level. The study employs secondary data which spans 1981 to 2021 and adopts Autoregressive Distributed Lag (ARDL) for the methodology. The choice of ARDL is to capture the impact for short- and long-run period. The findings from the study highlight the following: specific agricultural financing is found to be highly instrumental in promoting food production in the country. Aside this, food production is equally found to have much impact in reducing poverty level. This impact is assured in both short- and long-run periods. However, while available arable land significantly influences agricultural finance, it is much found to be sustained and long lived in the long run. Thus, the policy implication arising from this study gives necessity to a policy that will enhance credit facilities to the farmers and other supports that will ensure food surplus.

Keywords

agricultural financing, food production, poverty level, ARDL

JEL Classification: *G24, Q18, I32, B41.*

1. Introduction

Attempts to ensure sufficient food production for the entire world population is increasingly receiving critical attention (see Gassner et al., 2019; Tochukwu et al., 2022). While the United Nations focuses on reducing hunger through adequate food production, it is equally making effort to eradicate poverty

across the entire globe. The increasing effort to reduce poverty at global level is thus gaining momentum. According to United Nations, achieving no poverty across nations is necessarily a priority goal that must be achieved by the year 2030 (UN, 2022). However, the incidence of poverty level could be viewed either in monetary term or in multidimensional term. People who leave below $1.25 per day are said to be poor. Taking this monetary term into consideration and relating it to Nigeria, more than 40 % of Nigerian fall below this line (National Monetary Poverty Line survey, 2019).

However, the multidimensional survey in 2022 suggests that 63% of Nigerians representing 133 million people are multidimensionally poor. This statistic is deeply suggesting that many of this population are grossly deprived of adequate food production, quick attention for health facility, sanitation practice and adequate housing facility (NBS, 2022). Accordingly, the multidimensional poverty index is estimated as 0.257 which generally indicate that poor people in Nigeria experience more than one quarter of every possible form of deprivations in the country. Evidence from International Food Policy Research Institute (IFPRI) also suggests that global hunger index for the country is very high (see Figure A1 in the Appendix). While the cost of purchasing a healthy diet keep rising in Nigeria, the number of people and the percentage of population being unable to afford the cost has also been on a far increase (see Figure A2 in the Appendix). The issue of concern is however to investigate the role of finance in ensuring food production and by extension reduce poverty level in Nigeria.

While the statistic keeps rising for inadequate food production and rate of poverty level for Nigeria (see Figure A3 in the Appendix), the efficacy of food production in eradicating poverty in the country is now being vehemently upheld in the literature (see Kilima et al., 2013; Tochukwu et al., 2022). However, literature equally suggested that food production respond positively when there is adequate flow of fund into the sector (Ademola, 2019; Osabohien et al., 2020; Ebere et al., 2021). The implication from the foregoing is that having sufficient food security as way to eradicate poverty, presupposes adequate financing to the agricultural sector (see Cordelia, 2020). While the previous research effort has not carefully examined this implication (see Oriola, 2009; Eseyin et al., 2016; John and Dankawu, 2018; Omodero, 2021; Sikandar et al., 2021; Tochukwu et al., 2022), the very few studies with kind attention with respect to this subject matter has not been deeply rooted to analyzing the implication for both short- and long-run periods. Examining this analysis for both periods will reveal the potential implication for the nexus in both the immediate term and the period ahead. When policy makers are acquainted with adequate information on the implication of financing agricultural sector, necessary efforts are abounded to be taken to ensure adequate economic performance.

Our analysis in this regard thus takes cognizance of the possible impact of credit assistance to agricultural sector overtimes and its associated impact on food production. Expectedly, when farmers are presented with essential credit outlets, it becomes easy for them to engage in various farming activities which in the long run contributes to higher food production. Also, abundance food production

is bound to have some impact on the level of poverty for the economy. In fact, according to United nations, a way to achieve no poverty or at least reduce it will require sufficient food production. This thus goes to say that the policy to ensure adequate food production should be rooted in making necessary provision for farmers to have access to needed credit facility at little or no cost. In this study, our emphasis is to subject this notion to econometric analysis. Precisely, we are keen to know the extent to which credit facility will aid food production and to also verify the extent of possible impact of food production on reducing poverty level for Nigeria.

We employ Autoregressive Distributed Lag (ARDL) model for our analysis. This methodology is more instrumental for combining variables of different levels. While it is highly necessary for variables to be in the same level for other methodologies, ARDL model has the inbuilt capacity to accommodate variables at different levels and this makes its usage a necessity for the present study. Additionally, information therefrom with respect to study's outcome will be revealed for both short- and long-run periods. By implication, our analysis will provide information about the behaviour of the economy in the short term (with 1 to 3 years) and the periods after. The scope of study is also long enough which make it superb in comparison with any recent work in this regard. Having longer scope will give an opportunity to analysis the behaviour of the economy overtime, especially on issue relating to poverty reduction from the angle of funding and food production.

On the variables of measurement, we proxy agricultural financing with credit facility to agricultural sector while food production is captured through food production index. At the same time poverty level is measured through GDP per capita income. Their usage for analysis of this nature is not strange in the literature (see for example Tochukwu et al., 2022). However, we control for our model through the addition of share of arable land of total available agricultural land in the country. It was estimated that Nigeria has a total of 74 hectares of arable land for agricultural activities with additional 2.5 hectares of land which can be supported for farming through irrigation (see Oriola, 2009). We believe that application of funding for farming activities on fertile agricultural land will aid food production and eventually reduce poverty. Our findings are summarized as follows. While funding contributes to higher food production, the presence of arable agricultural land equally aids this production both in the short term and the period beyond. However, while food production and financing jointly influence poverty reduction in the short run, the contribution of agricultural financing could not be sustained through to the long run. In all, our findings have possible implications for the policy makers and other stakeholders in this line of research.

Immediately after this introduction is the brief literature review which is followed by the methodology and theoretical guidance for our study. In section 4, preliminary analysis with respect to variables of choice is provided where we extend the analysis to trend analysis of the co-movement among the variables. The results of findings are given in section 5 with emphasis on models relating to financing,

food production and poverty reduction and section 6 concludes our discussion.

2. Brief Literature Review

There are numerous studies that have been empirically conducted on the nexus between finance and production and between food production and poverty level. While many of these studies emphasize the role of agricultural financing in ensuring greater food production, some greater number of others equally argued for the importance of food securing in reducing poverty level in the for any country.

In making attempt on the link between agricultural credit and food security, Ayodeji and Oladokun (2018) investigate the nexus between agricultural output and poverty reduction in Nigeria through cointegration analysis. The study found evidence for the efficacy of governmental resources and credit facility in reducing poverty level in the country. Accordingly, the research effort by Gassner et al. (2019) also examines the extent to which food security could reduce poverty level in the country. The study holds that the efficacy of agricultural sector in reducing food insecurity was mitigated through non-availability of technological gadgets to reducing the level of poverty for the economy. A similar paper by Adomola (2019) explore the implication finance on agricultural output in Nigeria. The study uses secondary data with OLS methodology. The outcome of the study supports the earlier finding that finance spur agricultural growth. At the same time, Omodero (2021) examines the extent of connectedness among food sufficiency, agricultural sustainability and poverty reduction in Nigeria using annul data from 2009 and 2019. The finding from the study reveals that index of food security has potential impact in reducing poverty level. However, with granger causality test, Ebere et al. (2021) estimate the linkage between output from agricultural sector and agricultural credit in Nigeria with data scope ranging between 1981 and 2017. It was submitted that credit facility to agricultural sector contribute positively to level of agricultural output in the country.

Using another dimension, Aderemi et al. (2021) make use of annual data from 1981 to 2016 to investigate the connection between employment opportunity in agricultural sector and the extent of poverty reduction. The short analysis from the findings confirms the positive the connection between employment and poverty level. Sikandar et al. (2021) further examine the between food security and poverty reduction. The study revealed that both poverty reduction and the level agricultural export output and positively related. In an earlier study by Osabohien et al. (2020), the connection between Agric-related finance and food production was examined. The study essentially makes use of annual data spanning the period between 1981 and 2018 and the analysis was carried out by using cointegration method. The finding gives support to positive connection between finance and food production in Nigeria. In particular, with 1% rise in agricultural finance, food production is bound to rise on average of 0.003%. A more recent study by Omodero and Ehikioya, 2022 has also examined the extent to which agricultural output and finance will contribute to ensuring food security. In this study,

regression analysis was employed with data coverage from 2007 to 2019. The finding gives evidence in support of agricultural output in improving food security while the contribution of financial credit was not significant. As a result, it was recommended that there is need for government to increase its budget to agricultural sector in Nigeria to ensure food safety.

3. Theoretical Guidance and Methodology

The importance of finance for output growth has been theoretically and empirically emphasized in the literature (see Pagano, 1993; Bailliu, 2000; Adeola, 2017). According to endogenous growth model, the growth in output Y is ensured through technological progress which find its course through international trade and domestic saving from which domestic investment can be implemented. The popular AK model is specified as follows:

$$Y_t = AK_t \quad (1)$$

Where Y_t is economic output at period t, A is total factor productivity and K_t is economy's capital input at period t. If we invoke a condition that total economy's saving is invested and assume that current investment is function of change in investment (i.e., $K_{t+1} - K_t$) and capital consumption allowance (i.e., $\emptyset K_t$), then we can write a steady state equation by taking the growth rate effect of equation 1 as follows with some substitution and manipulations:

$$y = A\vartheta s_t - \emptyset \quad (2)$$

The implication equation 2 is that the impact of finance through savings can be passed to the economy through output growth whose further implication is assured for poverty reduction though rising GDP per capita. In line with this model, model specification can be made as follows:

$$lnPIF_t = \propto_0 + \propto_1 lnPIF_{t-1} + \propto_2 lnFIN_{t-1} + \propto_3 lnARL_{t-1} + \epsilon_t \quad (3)$$

$$lnGDPPC_t = \propto_0 + \propto_1 lnGDPPC_{t-1} + \propto_2 lnPIF_{t-1} + \propto_3 lnFIN_{t-1} + \epsilon_t \quad (4)$$

Equations 3 and 4 are representation of Models I and II, where in equation 3, production index for food (PIF) is a function of Agricultural finance (FIN) and available arable land (ARL). In equation 4, logarithm of GDP per capita is modelled as function of its lag and production index of food and finance. *Ápriori*, we expect each of the coefficient of regressors to be significant and positive. Both equations 3 and 4 can thus be specified using ARDL model as follows:

$$\Delta lPIF_t = \alpha_0 + \rho lPIF_{t-1} + \beta_1 lFIN_{t-1} + \beta_2 lARL_{t-1} + \sum_{j=i}^{p-1} \delta_i \Delta PIF_{t-i} + \sum_{j=i}^{s-1} \gamma_{1,i} \Delta lFIN_{t-i} + \sum_{j=i}^{r-1} \gamma_{2,j} \Delta ARL_{t-i} + \epsilon_t$$

$$\Delta lGDPPC_t = \alpha_0 + \rho lGDPPC_{t-1} + \beta_1 lPIF_{t-1} + \beta_2 lFIN_{t-1} + \sum_{j=i}^{p-1} \delta_i \Delta lGDPPC_{t-i} + \sum_{j=i}^{s-1} \gamma_{1,i} \Delta lPIF_{t-i} + \sum_{j=i}^{r-1} \gamma_{2,j} \Delta lFIN_{t-i} + \epsilon_t \quad (5)$$

All the variables are as previously defined. The ARDL model that is specified above is for both short – and long-run periods. As shown in the equations, the short run impact is represented by γ_1 and γ_2 as for each of the equations while the long run impact is captured by $\frac{\beta_1}{1-\rho}$ and $\frac{\beta_2}{1-\rho}$ respectively for PIF and FIN. The ECM term is $1-\rho$ in this analysis which indicates the extent to which it will take to establish equilibrium following any slight change.

4. Preliminary Analysis

This study deal with the implication of finance on food production in Nigeria and by extension, taking a look on how greater food production will further help to reduce poverty level in the country. Given this focus, the study proxy poverty level with gross domestic product per capita, food production with production index for food and agricultural finance with domestic credit assistance to agricultural sector by commercial banks. In the alternative model, Gross National Income and production index for rice (being one of the most consumed foods in the country) are used while share of arable land of the available agricultural land is used as control variable. Table 1 presents the summary statistics for these variables. While the mean values for GDPPC and GNIPC are respectively $1329 and $1244, the mean value for credit to agricultural sector is around 160 billion naira. The production indices for total food and rice range between 50 and 65 while average available arable land is around 49 hectares of land. By measure of spread which is demonstrated with the figures on skewness, the variables are all positively skewed except Production index for food and arable land. Also, the kurtosis measures the relative peakness of the variable. The first three variables, namely: GDPPC, GNIPC and PIF are relatively flat as they are below the threshold of 3 while the next three are peaked given their respective values of 4.27, 6.045 and 4.428 for PIR, FIN and ARL in that order. Going by the Jargue-Bera statistics (through its p-values), only three of these variables are normally distributed and these are PIR, FIN and ARL. Others are not. In all, there are 40 observations given the starting date of 1981 to 2021.

Table1. Summary Statistics

Variable	Mean	Std. Dev.	Skewness	Kurtosis	J-Bera	Probability	Observations	Source
GDPPC	1328.979	882.226	0.476	1.811	3.865	0.145	40	MTD
GNIPC	1243.750	819.355	0.590	1.975	4.069	0.131	40	MTD
PIF	65.974	26.957	-0.038	1.860	2.176	0.337	40	FAO
PIR	49.769	31.992	1.431	4.270	16.345	0.000	40	FAO
FIN	160.984	248.032	1.892	6.045	39.316	0.000	40	CBN
ARL	48.548	4.922	-1.380	4.428	16.090	0.000	40	FAO

Note: MAO indicates macrotrends data and can be accessed through www.macrotrends.net; CBN is central bank of Nigeria and FAO Food Agency Organization of the UN

Unit Root and Trend Analysis

As a matter of necessity and given our method of analysis, part of the required preliminary analysis is to test for the unit root of the choice of variables. This is actually carried out for this study and the outcome is presented in table 2. Going by the information in this table for both the outcome from ADF and Philip Peron unit roots test. According to this information, all the variables are I (1) except of the variable of financial credit, which in this case is I (2). Our model is built to accommodate this condition as exhibited by the variables. Hence, the use of ARDL for our study is adequately necessary. The graphical illustration of our variables of choice shows some co-movement among them. Particularly, the indices of food and rice production perfectly tracked the GDP per capita for the Nigerian economy (see Figure 1). This gives an indication that with higher food production, GDP per capita is more likely to improve and by implication reduce poverty level. Also, the share of available agricultural land of the total land in the country has not been significantly rising for over a score now while that of arable land out of the agricultural land has equally been stagnant since 2013 (see Figure 2). The implication is that agricultural output for the country might not have experience significant improvement during this period. However, agricultural financing and production indices for food and rice experience similar pattern except in the recent time when the entire world witnessed COVID-19 pandemic (see Figure 3), though employment rate in the sector is gradually found to be decreasing (see Figure A4 in the Appendix).

Table 2. Unit Root Test

ADF			, PP	
GDPPC	-4.0236*	I (1)	-3.9088*	I (1)
GNIPC	-1.8595***	I (1)	-3.2793*	I (1)
PIF	-1.8461***	I (1)	-7.5332*	I (1)
PIR	-4.5556*	I (1)	-6.1795*	I (1)
FIN	-8.8376*	I (2)	-8.5590*	I (2)
ARL	-4.9686*	I (1)	-4.8987*	I (1)

*Note: *, **, and *** indicate 1%, 5% and 10% level of significance respectively*

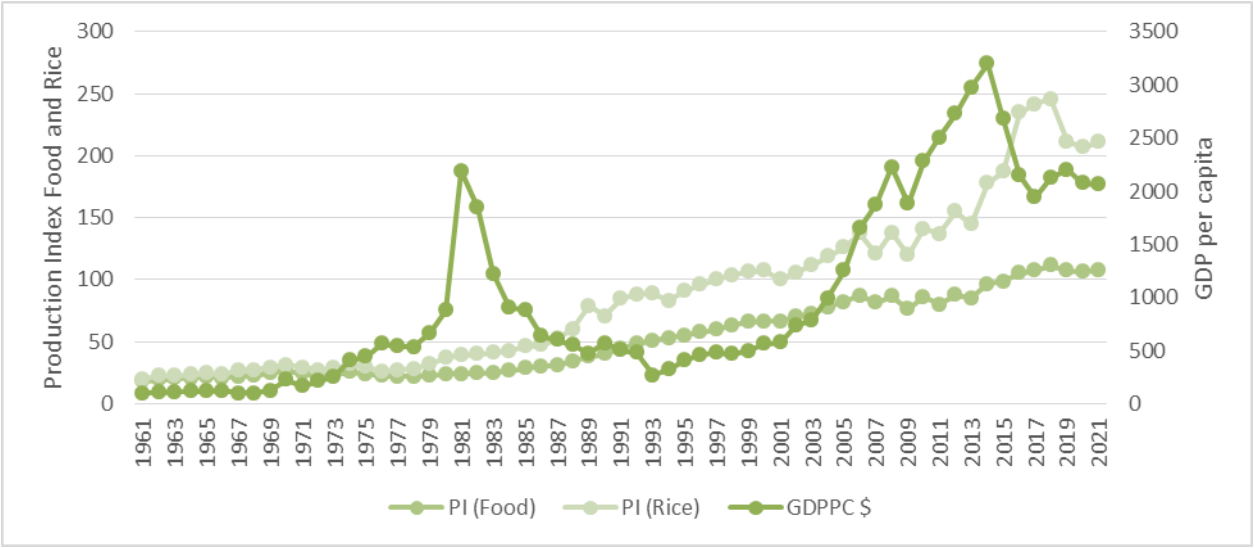

Figure 1. Co-movement among Food Production Index, Rice Production Index and GDP Per Capita for Nigeria (Data source: FAO Statistics)

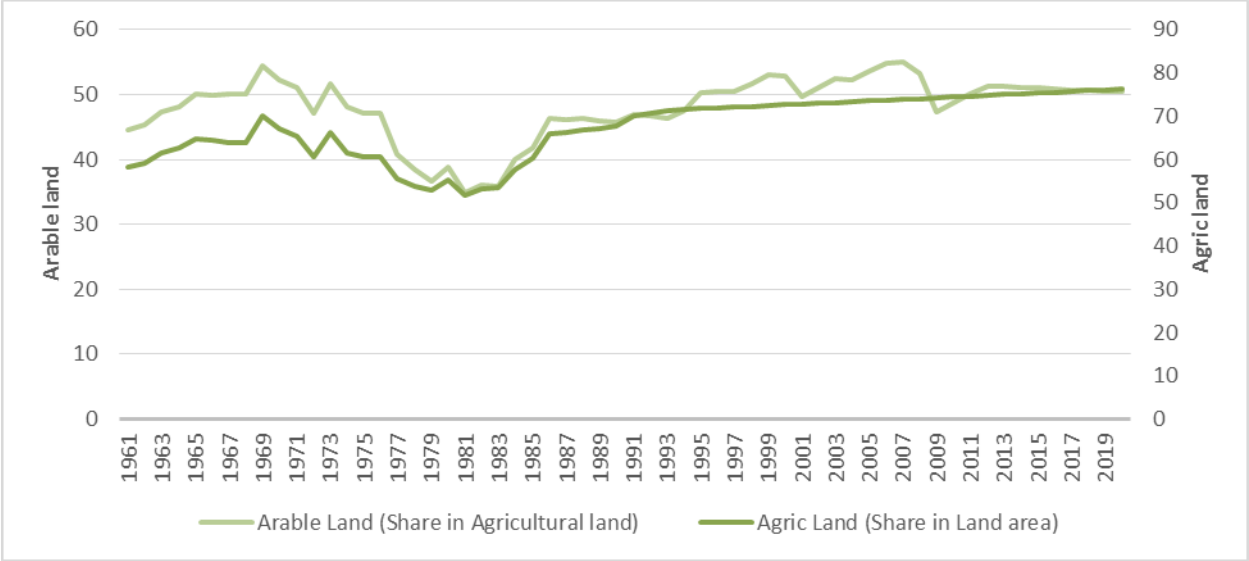

Figure 2. Co-movement between Available Arable Land and Agricultural Land in Nigeria between 1961 and 2018 (Data source: FAO Statistics)

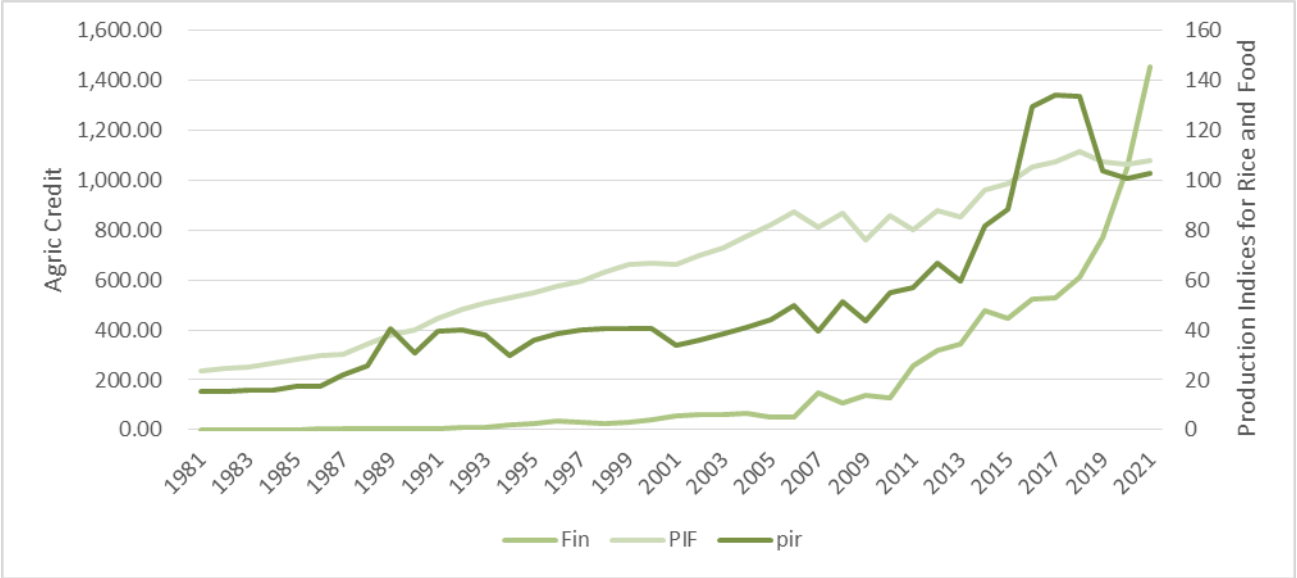

Figure 3. Co-movement among Agricultural Credit, Production Index for Food and Rice in Nigeria between 1981 and 2021 (Data source: CBN bulletins and FAO Statistics)

5. Results

We specifically attend to the focus of this study by making two models for our analysis. In the first model, we address the issue relating to agricultural finance and food production where we have the result for both short- and long-run evaluation (see Table 3). In the short run, the impact of finance on

food production, though not instantaneous, is significant at 1% level with magnitude of 0.046 while that from available arable land is immediate and significant. This gives an implication that farmers need some lag period (an average of one year) to process any available funding for farming activities while the process to utilize the available arable land may be not necessarily delay. In the long run, this impact is positively and significantly upheld for both finance and arable land. However, as shown by the co-integration equation, with any changes in the short run, it will only take 29.3 rate to normalize (this is confirmed with the magnitude of the associated variable which in this case is -0. 2934). For robustness analysis, we proxy food production index with rice production index and see whether the outcome will be similar. Indeed, the two variables are found to be instrumental as determinants of rice production for both short- and long-run periods. The sign is positive and significant. It is also worthy to emphasize that break point is noticed in the year 2014 through graphical inspection of the dependent variable and this is taken care in the implementation of our analysis. The F-bound test also confirms the strength of our model.

Table 3. Model I: Finance and Food Production

Variable	Short Run			Long Run	
	coefficient	p-value		Coefficient	p-value
LPIF (-1)	-0.2935	0.0013			
LFIN (-1)	0.0462	0.0058	LFIN	0.1573	0.0000
LARL	0.2743	0.0007	LARL	0.9346	0.0000
Coint-Eq (-1) *	-0.2934	0.0000			
ALTERNATIVE PROXY USING PIF					
Variable	Short Run			Long Run	
	coefficient	p-value		Coefficient	p-value
LPIR (-1)	-0.4935	0.0036			
LFIN (-1)	0.0792	0.0195	LFIN	0.1606	0.0000
LARL	0.4021	0.0019	LARL	0.8148	0.0000
Coint-Eq (-1) *	-0.4935	0.0002			
F-Bound Test				**F-stat**	
Required	3.8800			Actual	5.3000
Break-Point	2014			decision level	@ 1%

Note: LPIF and LPIR are log of production indices for food and rice respectively while LFIN and LARL are log of credit to agricultural sector and arable land being a share of available agricultural land in that order. The break point occurs in 2014 which is confirmed through graphical inspection.

In the second model, we focus on the investigation of the impact of food production on poverty reduction in Nigeria and verify whether agricultural finance will have an extended impact in improving the level of GDP per capita. The model is equally presented for both short- and long run (see Table 4). In the short run, food production index is found to have significant and positive impact on the level of GDP per capita with magnitude of 0.147 (at 5% level). By implication, with 100% positive change in food production, GDP per capita will improve by 14.7% which, by extension, reduces the level of poverty through improvement in the per capita income of the entire citizens. The long-run impact of food production index is also upheld with higher magnitude. In fact, the result clearly shows that the economy will have better experience in terms of contribution of food production to GDP per capita. However, while finance contributes positively to reducing the poverty in the short, such impact is found to dissipate in the long run. In other words, while the implication of agricultural finance is strong for food production, its extended impact on GDP per capita cannot be sustained for the Nigerian economy. As expected, this impact could have possibly mediated through food production to income per capita. In the alternative model, GNI per capita is used in lieu of GDP per capita and the associated results indicate the robustness of our analysis (see table 4). The run drift for any disequilibrium is only 10.4% (as shown by the coefficient of co-integration equation) while the model is strong given the result of F-bound statistics at 1% level of significance. Through graphical inspection of GDP per capita, we incorporate break point of 2015 in our model and it is found to be significant.

Table 4. Model II: Food Production and Poverty Reduction

Variable	Short Run			Long Run	
	Coefficient	p-value		coefficient	p-value
LGDPPC (-1)	-0.1035	-0.0052			
LPIF	0.1466	0.0356	LPIF	1.4159	0.0000
LFIN	0.0382	0.0496	LFIN	0.3694	0.1681
CointEq(-1)*	-0.1035	0.0000			
ALTERNATIVE PROXY USING GNIPC					
Variable	Short Run			Long Run	
	Coefficient	p-value		coefficient	p-value
LGNIPC (-1)	-0.0659	0.0144			
LPIF	0.1041	0.0349	LPIF	1.5802	0.0000
LFIN	0.0067	0.5602	LFIN	0.1009	0.5974
Coint-Eq (-1) *	-0.0658	0.0033			
F-Bound Test				**F-stat**	
Required	3.88			Actual	5.30

Break-Point	2015	decision level	@ 1%

Note: LPIF and LFIN are log of production index for food and log of credit to agricultural sector while LGDPPC and LGNIPC are respectively log of GDP and GNI per capita for Nigeria. The break point occurs in 2015 and this is confirmed through graphical inspection.

6. Conclusion

In this analysis, we provide a research evaluation on the implication of agricultural finance on food production and the extended impact in reducing the level of poverty in Nigeria. Our scope range between 1981 and 2021 where we address the objective of the study through the use of Autoregressive distributed lag. This methodology becomes instrumental given the features exhibited by the variables of choice. As a way to decisively attend to the focus of our study, we decimate our evaluation into two: model I where the impact of agricultural finance is investigated for food production and model II where the extended impact of food production is evaluated for poverty reduction in Nigeria. The impact is captured for both short- and long-run periods.

In the first model, agricultural finance proxied through credit facility to agricultural sector is found to have significant and positive impact on food production which we proxied by food production index. This impact is delayed for a lag of one period and by implication, suggests that farmers necessarily need some lag period to process any available fund for agricultural activities. The impact arising from arable land is equally positive and significant on food production for both runs. In the alternative model, rice production is used instead of food production index. The idea here is largely depended on making robustness check for this model. The outcome therefrom is similar to the initial analysis. In the second model, the implication of food production is estimated for poverty reduction in Nigeria for both short- and long-run periods. While the impact of food production and agricultural finance is evident for poverty reduction in the short run, the impact of finance could not be sustained through to the long run period. In the alternative estimation, GNI per capita is used in lieu of GDP per capita. The outcome further suggests the initial conclusion for when GDP per capita is employed.

The policy arising from our analysis is found in the necessity of agricultural finance for the farming activities of food crops. With adequate credit accessibility by the farmers, the production of food crops will be assured and its extended impact will become pronounced in poverty reduction. However, as suggested by our findings, the finance impact of credit facility is not often instantaneous, hence the need to make agricultural fund before time in anticipation for future benefit through food surplus.

Conflict of Interest

All authors have declared no conflict of interest toward the publication of this research paper.

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Notes

Note 1. This paper was presented on 10th of May, 2023 at Circularity Conference organized by IMAGES and hosted by International Institute of Tropical Agriculture (IITA), Ibadan, Nigeria. The leading author presented the paper on behalf of others.

Appendix

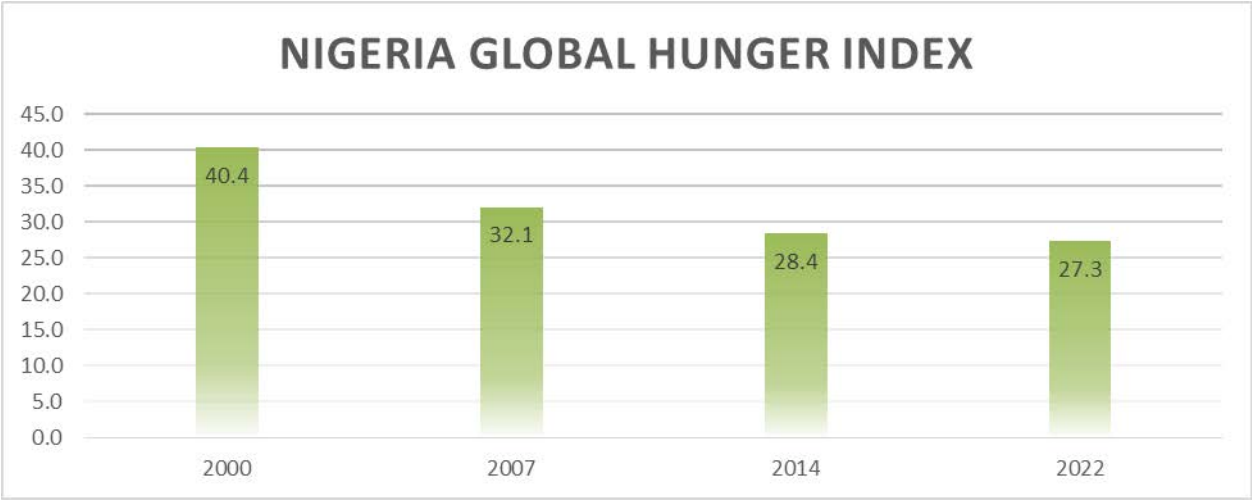

Figure A1. Global Hunger Index for Nigerian between 2000 and 2022 (Data source: International Food Policy Research Institute, IFPRI)

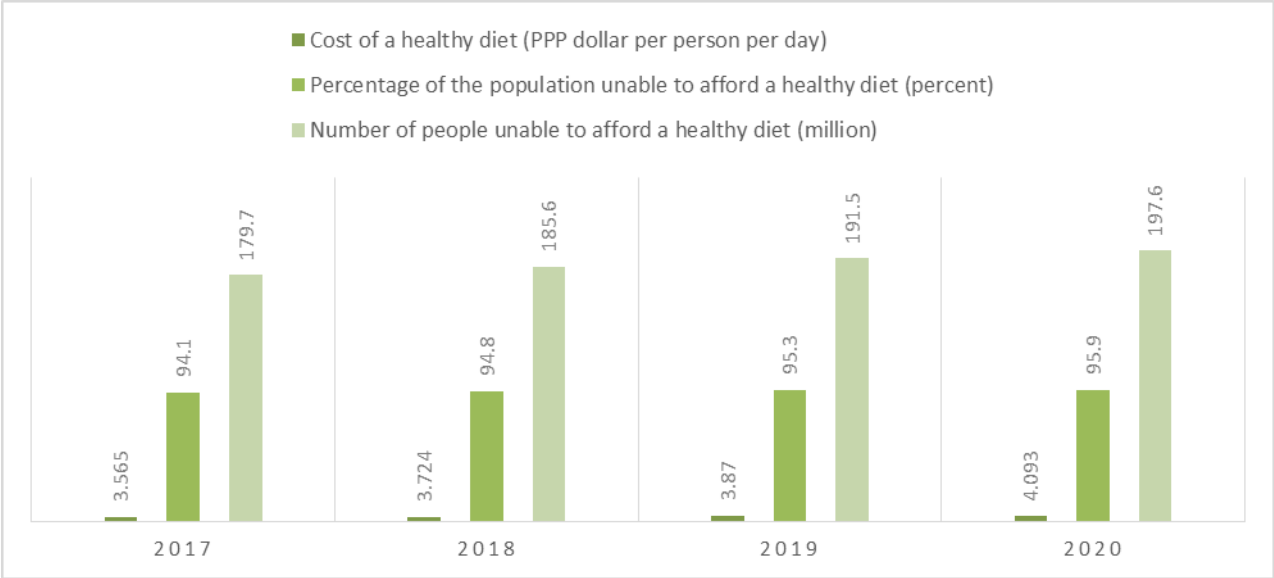

Figure A2. Connectedness between Cost of Healthy Diet and Number of Population Unable to Afford it (Data source: FAO Statistics)

Figure A3. Poverty Rate for Nigerian between 1985 and 2018 (Data source: www.macrotrends.net)

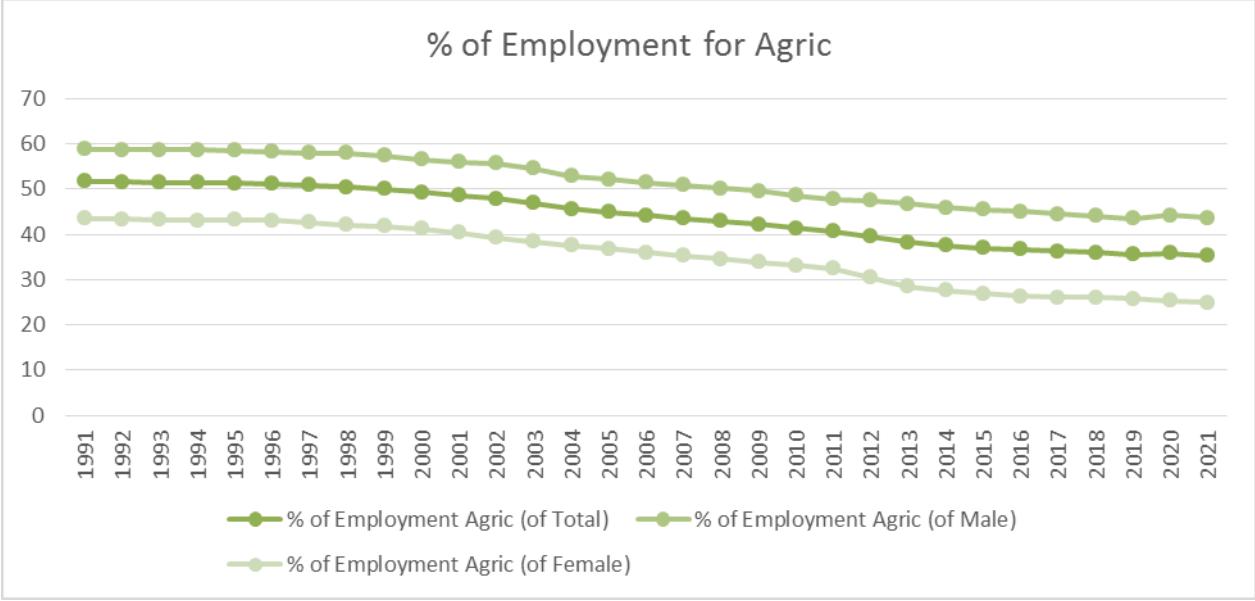

Figure A4. Employment Rate in Agricultural Sector in Nigeria between 1991 and 2021 (Data source: FAO Statistics)