Linkage Effects of Agriculture Expenditure on Food Security in Nigeria

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Abstract
This study examined the linkage effect of agriculture expenditure on food security in Nigeria. Pertinent time series data ranging from 1981 to 2022 were adopted for the research analysis. For testing the existence or lack of a unit root in the series and an endogeneity issue in the model, we employed the Phillip Perron and simultaneity tests. In assessing the nature of relationship among agriculture expenditure, climate change, security index, population growth rate, agricultural mechanization and food security; two stage least squares approach was employed. The study found that Nigeria's food security is significantly impacted by agriculture expenditure, climate change, and security index. During this study period, agricultural mechanization had a considerable detrimental influence on food security. However, population expansion showed a negligible improvement in food security. We conclude by urging an increase in agricultural spending in line with the 2003 Maputo Declaration's recommendations. Once more, Nigerian farmers should be pushed to embrace climate smart farming practices by publicizing them.
Keywords*: Agriculture Expenditure, Food Security, Nigeria, Climate Change.*

Introduction

The modern role of government has widened beyond the scope of protection of lives and properties as was propounded by the classical economists. Today, government responsibilities' have stemmed into development of her key social and

economic sectors like transportation, health, education and agriculture through budgetary expenditures; as a means of achieving sustainable economic growth.

Agriculture sector is vital to development of any economy considering its role in the provision food residents, raw materials to industries, income and employment opportunities to farmers, as well as improving the welfare of citizenry (Edeh, Eze & Ugwuanyi, 2020). This justifies the prioritisation of agriculture as one of the key sectors that demands more expenditure from the government both at the global, regional and national levels.

One of the expense categories among the different government functions is the investment in agriculture sector. For instance, governments spent 1.5 to 2.2 percent of their overall spending on agriculture between 2001 and 2021, yet the industry generated 3.1 to 4.5 percent of global GDP during that time. The proportion of agriculture expenditures in total government budget peaked in 2019 at 2.16 percent before falling to 2.08 percent in 2020 and 1.97 percent in 2021. The COVID-19 epidemic and the crisis in food prices in 2007–2008 were two significant events that changed spending trends in the agriculture industry. The percentage of spending on agriculture fell to 1.5 percent between 2005 and 2007, but it increased during the food price crisis, rising from 1.64 percent in 2008 to 2.10 percent in 2015. The period's high food costs prompted nations to increase their agricultural spending in an effort to support small farmers and boost output (FAO, 2022).

Locations wise and based on her primary occupation, African countries have been curios to improving agricultural sector for higher productivity. Consequently, increasing agricultural output which is synonymous to food security has been a major issue for African nations over time. A Declaration on agriculture and food security in Africa was endorsed by African Heads of State at the Second Ordinary Assembly of the African Union (AU) in July 2003 in Maputo, Mozambique. This was done in recognition of the role agriculture expenditure can play in economic development generally and as a crucial tool in promoting food security specifically. The Declaration includes several significant agricultural policy measures, but a stand out: allocating at least 10% of the national budget to agriculture sector for the actualization of at least 6% annual growth (Ebi, 2018). The question is “has Nigeria met up with the above declaration of AU in her commitment to agriculture expenditure”?

In Nigeria, there have been significant swings in the amount of governmental expenditure on agriculture compared to the size of the sector over the past 25 years. Such a funding pattern obviously does not fit the industry, which is regarded to be a key engine of the nation's prosperity and reduction of poverty (Oxfarm,

2019). Concerned about this poor trend, which has been linked to the rising food crisis across the country, particularly in the recent years, key players in the agricultural sector have girded their loins to persuade the upward review of the sector's budgetary allocation across the various levels of government (Gbenga, 2022). Their argument was based on the notion that improving agriculture expenditure will likely improve food security in Nigeria.

"Food security exists when all people, at all times, have physical and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (World Food Summit, 1996). This can further be broken into: food availability, food access, food utilization and food stability. Food availability which our study will be focusing on due to her quantitative compliance refers to "the sufficient quantities of food available for consumption at any point in time which can be supplied through importation or local production" (FAO, 2022). Food access implies access by individuals to adequate resources (entitlements) for acquiring appropriate foods for a nutritious diet. Entitlements here are defined as the set of all commodity bundles over which a person can establish command given the legal, political, economic and social arrangements of the community in which they live (including traditional rights such as access to common resources). Food utilization denotes consumption of food through adequate diet, clean water, sanitation and health care to reach a state of nutritional well-being where all physiological needs are met. This brings out the importance of non-food inputs in food security. Food stability indicating to be food secure, shows that a population, household or individual must have access to adequate food at all times. They should not risk losing access to food as a consequence of sudden shocks (e.g. an economic or climatic crisis) or cyclical events (FAO, 2022). One of the current goals of every economy is to achieve food security particularly in the sub-Saharan African countries with rising population growth rate. This is due to assumed inverse relationship between the two variables in the economy. According to Iwu (2020), the issue of consistent population rise and food security problem has been of serious worry to developing countries of Sub Saharan countries. This is predominantly observed in Nigeria where 2.7% of her population growth rate is commonly among the unemployed youths. Unfortunately, agriculture sector has not been made attractive to absorb these unemployed youths as well as increasing the level of food security in the country. Owo (2021) submitted that in Nigeria, about 14 million citizens including children suffered from malnourishment. This signalled that, about 21.4% of Nigerian population faced acute hunger between 2020 and 2018 as recorded by Iwu (2020). Outside high

population growth, other variables including climate change, agricultural mechanization, food imports and security have been identified as exerting influences on food security in Nigeria.

Various proportions of food security in Nigeria have been influenced by the climate change (Mbow *et al.* 2019; FAO, IFAD, UNICEF, WFP, and WHO, 2012). Through its effect on crop yields, climate change already has an impact on food supply, and the negative effects have typically outweighed the good effects (Pachauri *et al.*, 2014; Harvey et al., 2018). Food shortages result in higher food prices, which would lower many households' purchasing power (FEWS NET, 2022). All these assertions postulate that climate change effects on the food security cannot be over-emphasised, and has called for urgent attention for all stakeholders.

Agriculture-related technological solutions could buck this tendency. A significant amount of money would need to be spent on mechanization of agriculture; including the expense of importing capital goods and funding R&D. Mechanization would help the industry regain its former prominence as a significant source of foreign exchange revenues (Makanjuola, 2019). To meet the goals of food security, mechanization of agriculture needs to be made a worthy national priority and an enhancer on agricultural productivity. Thus, machine use in agricultural production in Nigeria began over 40 years ago, and has significantly grown over the last 10 years. Innovations in agricultural equipment are important for changing livelihoods in Nigeria and improving food security. Many tools and pieces of equipment, from tillage to processing, have been created by Nigerian agricultural engineers (Makanjuola, 2019). These include the Proda Cassava Peeling Machine, the Batch Process Cassava Peeling Machine, and the Proda Garri Frying Machine. Others are Reciprocating Triple-Sieve Multi-Grain Separator, which has the lowest per capita food supply in the world with just 2100 kilocalories per person daily (FAO, 2016).

Historically, domestic food production, commercial food imports, and food aid have been the three main avenues via which a nation might attain national food security (FAO, 2007). Food security can be achieved in a number of ways, and while food self-sufficiency is one of them, in practice most nations are compelled to rely on a mix of local production and imports, occasionally reinforced by food aid. However, relying more on imported food for human use not only represents a waste of resources but also poses a threat to the overall development and future of the agricultural sector of the country's economy (Dioume, 2015). The United Nations Food and Agriculture Organization (FAO) classify the majority of sub-Saharan African nations as low-income, food-deficit

countries (LIFDC). To meet the rising need for food, they heavily rely on imports, yet they don't support the policies that encourage domestic agricultural output (AFDB, 2014). However, there are significant disparities in the levels of dependency and, consequently, food insecurity. The over-reliance of African nations on food imports to address food security problems has social, political, and economic ramifications. The majority of African nations struggle to pay their food import expenses because their export incomes are meagre. This brings attention to the issue of food import dependency, in particular the challenges that these nations' governments and citizens have in trying to find ways to pay for the increasing import costs. Additionally, relying on food imports exposes nations with fragile economies to rapidly rising and unstable food prices (Dioume, 2015).

Nigeria has had effects from national insecurity over time. Conflicts between farmers and herders in some areas of the north have resulted in crises that have resulted in the deaths of several Nigerians, their displacement from their homes, and the destruction of their farms. Due to the farmers' inability to produce enough food in these areas, the situation has made food inflation in the country worse (Premium Times, 2023). The National Bureau of Statistics reports that from the 23.75 percent recorded in December 2022 to the 24.32 percent reported in January 2023, food inflation increased to its highest level in the previous four years. According to projections made by the FAO for 2023, 25.3 million Nigerians will experience severe food insecurity. This number is more than the 19.5 million people that the same group predicted would exist in 2022. Although the initial witness of insecurity and food security in Nigeria was primarily in the north, it has since spread to the south. Every farmer presently faces a major danger to food production in all rural communities in Nigeria. In accordance with FAO report, "acute food insecurity is primarily driven by the deterioration of security conditions and conflicts in northern states, which as of March 2022 (latest data available) have resulted in the displacement of approximately 3.17 million people and are restricting farmers' access to their lands."

Nigeria has a population of almost 200 million, yet its agricultural output is insufficient to supply all the food that it’s expanding population needs, widening the country's food supply and demand imbalance. Nigeria has had extremely low yields per hectare over the past few years as a result of shortages in the provision of inputs like seedlings and fertilizer as well as insufficient irrigation and harvesting systems, which reduce productivity and yield rates. Inefficient agricultural practices, such as using hoes and cutlasses, lower productivity since they are stressful and time-consuming. Nigeria's agricultural

output has decreased in quantity as a result of its failure to adopt advanced mechanized technologies (Taiwo, 2020). The negative effect of climate has also contributed in fuelling farmer-herder crises in almost all the agricultural zones in the country.

According to PWC report (2020), nomadic herders are now migrating to the south of Nigeria in search of grazing land and water for their cattle due to desertification and water depletion in the northern part of the country. As a result, there has been violent conflict with southern crop producers. Nigeria's food production output is decreasing as a result of rising violence in the states that produce food. The farming sector still lacks enough access to funding, despite the Nigerian government offering many facilities through the Central Bank of Nigeria (CBN), including the Anchor Borrower's Programme to help give small-scale farmers with adequate financing. This is against the tenets of 10% of total budgetary allocations to agriculture sector as stipulated in Maputo declaration. The issue of funding to agriculture sector remains a debatable one, in the sense that while some argued in favour of the current agriculture expenditure; others disputed the viability of such funding to achieving food security. Following the argument of the former and the reports from the FAO in the subsequent paragraph; the quest for evaluating the linkage effect of agricultural expenditure on food security is justified.

A recent review of Nigerian food security situation by the relief web show that if immediate action is not done, an estimated 4.3 million people in north-east Nigeria could experience severe hunger at this year's lean season's peak (June to August). The March 2023 Cadre Harmonisé (CH) food and nutrition analysis supports this. According to the CH report, approximately 500,000 people in the states of Borno, Adamawa, and Yobe (BAY) will experience a food emergency throughout the anticipated time frame. Many people in northeast Nigeria are still unable to produce the food they need or earn a living as a result of years of persistent conflict and violence. The CH research also named the Central Bank of Nigeria's (CBN) currency re-design strategy as one of the major factors contributing to food insecurity and its effects on market efficiency.

Based on the reports of UN Office for the Coordination of Humanitarian Affairs, food security was significantly impacted by the terrible floods of 2022 that damaged nearly 700,000 hectares of crop land across 34 states. The ability of individuals to buy food has also been hampered by extremely high levels of food inflation (22.04%), which has been made worse by Nigeria's protracted state wide petrol shortage, which has driven up the price of transportation and other goods. This could also be attributed to climate

change effect on weather which has varied the seasons for peak rainfall. This has also called for a swifter action to encourage all year round farming to ensure food availability for domestic consumption.

Though food security situation in Nigeria has been plagued by serious challenges arising from inadequate funding, climate change and porosity of our security architecture in the recent years; yet the government has not slept over the critical issues bedevilling food security in the country; which made her to have rolled out many agricultural programmes and policies for achieving food security over the years. Nigerian government through her fiscal strategies has also increased her expenditure to agriculture sector to facilitate agricultural mechanization; and cushioning the effects of food shortages through importation of foods. Thus, this study sets out to achieve the following objectives:

- Identifying the effect of agriculture expenditure on food security.
- Investigating climate change relationship with food security in Nigeria.

This study also, is structured into five sections. As section one has already been explored, sections two and three will deal with literature review and research methodology respectively; while sections four and five will take care of discussion of findings and policy recommendations in that order.

Theoretical and Empirical Review

Wagner's Theory

According to this theory, an increase in public expenditure will result in a national income gain that is greater than proportionate, which will cause a relative expansion of the public sector. In that this study also emphasizes the necessity for public expenditure to increase the production of the agricultural sector in order to achieve food security; this theory and the study's focus are complementary. The term "output" in this context refers to increased agricultural productivity, which is synonymous to food security (Wagner, 1883).

Endogenous Growth Theory

The Endogenous (AK model) growth theory served as the foundation for this study. According to the endogenous growth theory, internal rather than external influences account for the majority of economic growth. According to this hypothesis, spending on human capital, innovation, and knowledge significantly boosts economic growth (Idoko & Jatto, 2018). Given economic growth here as a dependent variable for other explanatory variables influencing them, we assume food security to be synonymous with economic growth while innovations and human capital spending could be substituted with farm mechanization and agriculture expenditure respectively.

The simplest endogenous model, the AK model, assumes a constant

external saving rate as well as a constant endogenous growth rate. It models technological advancement using just one variable, A. It bases endogenous growth on the supposition that the production function does not display diminishing returns to scale. This premise has been supported by a number of arguments, such as the positive economic spill-over from capital expenditure or the upward spiral of technological advancements. The endogenous growth theory, however, is further bolstered by models in which actors determined consuming and saving in the best possible way while also allocating resources to research and development that advances technology (Romer, 1990).

Considering the production function:

$Y(t) = AK(t)$.....(1)

Which, when applied to the total capital stock, is linear. Assume n is the population growth rate. Where K is the capital and A is a positive constant that represents the level of technology. The growth rate of output per capita is thus equivalent to the growth rate of capital per capita:

$$y(t)/y(t) = k(t)/k(t) \text{.....(2)}$$

In terms of per capita growth, the Solow growth equation is:

$k(t) = sAk(t)-(\delta + n)k(t)$.....(3)

$$k(t)/k(t) = (\delta + n) \text{.....(4)}$$

This implies that both capital and production increase continuously at the same rate.

$g\gamma = sA - (\delta + n)$.....(5)

Despite the lack of exogenous productivity growth, as long as this economy shows positive long-term growth, that is $sA - (\delta + n)$. Endogenous growth models are those that experience growth in production per capita without the aid of exogenous technological advancement.

Empirical Review

In order for agricultural technology to be adopted, scaled up, and advanced, there must be market failure, including imperfect markets and information asymmetry (Benin *et al.*, 2012). The social justification for government expenditure is the distribution of income and eradication of poverty through availability of foods. Numerous studies on the value of government expenditure in boosting the economy through agricultural productivity have also been carried out in Nigeria; some of these are briefly reviewed here.

In their descriptive analysis on agriculture public spending in Nigeria, Mogues *et al*. (2008) showed that public investment on agriculture is incredibly low. When compared to spending in other important industries like education, health care, and water, they showed that less than 2% of all federal spending went toward agriculture. They showed that the spending on agriculture is well below

the 10% target outlined by African leaders in the 2003 Maputo Declaration, in stark contrast to the sector's importance to the Nigerian economy and the policy emphasis on diversifying away from oil. They recommended the necessity for an applied study to address significant information gaps in agriculture expenditure in Nigeria because their study was only exploratory in nature.

Iganiga and Unemhilin (2011) conducted research on the value of agricultural output in Nigeria and the impact of federal government agriculture expenditure and other agricultural production-related factors. It called for a Cobb Douglas growth model that took into account consumer price index, annual average rainfall, commercial credits to agriculture, population growth rate, food importation, and GDP growth rate. The value of agricultural output was examined for both long- and short-term dynamic impacts using co-integration and error correction methodology. Their findings demonstrated a positive relationship between capital spending by the federal government and agricultural output. However, because it cast doubt on the idea of program placement effects in their analysis, the study did not take into account the endogeneity of agricultural public spending.

The relationship between public expenditure, private investment, and agricultural sector growth in Nigeria was examined by Udoh (2011). Their growth model integrated elements like agricultural output, labor force participation rate, gross fixed capital formation, and total foreign direct investment using data from 1970 to 2008. His study's use of the VECM model revealed a short-run positive link between public spending and output. The effects of other agricultural spending components on the agricultural sector in Nigeria were not taken into account in this study.

Lawal (2011) made an effort to confirm the amount of federal government spending on agriculture during a thirty-year period (1979–2007) using time series data. The study demonstrated that agricultural expenditure does not follow a predictable pattern and that the GDP contribution of the agricultural sector is directly correlated with government support to the sector using trend analysis and a straightforward linear regression. He may not have been able to handle the intricate relationship between government spending and agricultural productivity with the simple linear equation approach he utilized.

Itodo, Apeh and Adeshina (2012) used the Cob-Douglas production function and the ordinary least square (OLS) econometric technique to estimate a multiple regression of agricultural output against a number of variables as they looked at the effects of government spending on agriculture and agricultural output in Nigeria from 1975 to 2010. Within the parameters of their investigation, the findings showed a positive but unimportant link

between government spending on agriculture and agricultural output. This result might be skewed since the OLS methodology they used was less effective than the Generalized Least Squares strategy used in the Seemingly Unrelated Regression (SUR) model, despite being consistent and impartial.

Ihugba, Nwosu and Njoku (2013) used time series data from 1980 to 2011 to experimentally assess the relationship between Nigerian government spending on the agricultural sector and its contribution to economic growth. They used the Engle-Granger two step modelling (EGM) method to co-integrate based on pairwise Granger Causality tests and unconstrained Error Correction Model. Their analysis revealed a cointegration between the contribution of agriculture to the GDP and total government spending on agriculture. They came to the conclusion that any decrease in government spending on agriculture would be detrimental to Nigeria's economic expansion. There are several possible connections between government spending and GDP. As a result, the single equation model used in this work might not be able to account for all of the linkages (Greene, 2012). This can potentially raise questions about the study's projected findings.

Olomola *et al.* (2014) found that despite the sector's importance in the fight against poverty, hunger, and unemployment as well as in the pursuit of economic development, Nigeria's budgetary allocation to agriculture is low when compared to other important sectors. Their conclusions regarding the benefit incidence of government spending on fertilizer subsidies imply that the program's intended target group has not reaped the benefits. They advocated the necessity for effect analyses of pertinent agricultural public expenditure components in Nigeria, particularly those that account for a larger portion of the expenditure.

In (2015), Ewubare and Eyitope investigated the impact of government spending on Nigeria's agriculture industry. The analysis made use of the Johansen co-integration methods, the error correction model, and the ordinary least square (OLS) of multiple regressions. They made the implication that government spending benefits Nigeria's agriculture industry. They advocated increasing support for Nigeria's agriculture industry in light of the aforementioned findings. The study did not evaluate whether agricultural public spending is an outcome or a cause of agricultural output, which could have skewed the results in either a positive or negative direction.

Ayunku and Etale (2015) looked specifically at sectorial expenditure analysis to examine the impact of agriculture spending on economic growth in Nigeria from 1977 to 2010. Johansen Cointegration, Augmented Dickey Fuller (ADF), and Phillips Perron (PP) unit root tests, along with Error Correction Model (ECM) tests, were all used in the study. Their empirical findings showed that

changes in the Real GDP were significantly influenced by changes in the Nigerian economy's exchange rate, interest rate, inflation rate, and agricultural expenditures (AGR, INF, INT, and EXR). In light of this, they suggested, among other things, that the government increase spending on agriculture. However, they neglected to include in their analysis that the impact of agricultural public expenditure may not be immediate (it may manifest with lag), which may raise questions about the study's estimates.

In 2020, Osabohien, Adeleye, and De Alwis investigated the effects of agro-financing on food production in Nigeria. According to the findings, a 1% increase in farmers' access to agricultural financing is linked to a 0.002%–0.006% increase in food output, depending on the model's parameters. According to the report, one of the issues limiting agricultural productivity is farmers' difficulty to obtain finance because of the industry's perceived risk and unpredictability. According to the report, in order to ensure food security in Nigeria, more finance should be given to the agricultural sector with lenient credit requirements. Additionally, more fertile land should be set aside for farming.

The contribution of agriculture to providing food security in emerging nations, including Nigeria, was evaluated by Pawlak and Magorzata (2020). The study made the point that while the agriculture sector actively works to increase food availability in both rich and developing nations of the world, food security has grown to be a problem of paramount concern for nations with varying levels of economic development. The study used cluster analysis; the findings show that oil producers with diverse economic development levels, such as Iraq, Angola, Nigeria, or Ecuador, who are located on separate continents, were impacted by the physical and/or economic unavailability of food.

In general, the majority of studies on government agriculture expenditure in Nigeria reviewed above failed to take endogeneity problem into account, which could have resulted in estimations of the effects of government expenditure]with simultaneity problem.. Additionally, they overlooked the lag time between public investment and its effects. Because government expenditure decisions at any one time may be influenced by past decisions and results, their findings may be biased (Benin, Mogues, Cudjoe, & Randriamamonjy, 2009). They all employed single equation estimating methods, which may not be as effective as systems of equations methods since public investments have a multiplicity of effects on production (Fan, Hazell & Thorat, 2000). Therefore, since changes in public investments are not directly linked to changes in outcomes policy implications from single equation research may be deceptive (Herrera, 2007). All these identified gaps will be

filled in the current study through the adoption of 2stage least squares and system equations analytical method.

Methodology

The aggregate production concept put forward by Ewubare and Eyitope (2015) was used in our investigation. The aggregate production framework is an expansion of the traditional production function, which stresses labour and capital as the primary components of production, to analyze the effects of additional factors like government spending, climate change, agriculture mechanization, and others on food security.

The typical form of the function connecting total output in period t with inputs or production factors is given as follows:

$Y(t) = A(t)K(t)L(t)$.....(6)

Udoh (2011) asserts that the total factor productivity (A) may have a role in how government spending in the agriculture sector affects output growth, and subsequently, food security. He therefore presumptively assumed that TFP is a function of agriculture expenditure (AGE) and other exogenous factors (Z). While K stands for investment in agriculture mechanization (AGM), we modelled L as Nigeria's population growth rate (POPGR), which has an impact on food security of its own. Due to its impact on agricultural production, we also added climate change (CC) as a factor affecting total factor productivity. Last but not least, security (SECI) was added to the TFP model because it has been determined that security can improve the environment for agro-investment and farmer resilience to agricultural productivity. Additionally, the degree of security offered to farmers directly correlates with their ability to produce at their peak levels.

The Total Factor Productivity can therefore be modelled as follows:

$A_t = f(AGE_t, AGM_t, POPGR_t, CC_t, SECI_t, Z)$…….....(7)

We can explicitly express equation (7) as thus:

$A_t = AGE_t\ AGM_t\ POPGR_t\ CC_t\ SECI_t\ Z_t$ …….....(8)

The combination of equations 6, 7 and 8 will give us:

$Y_t = Z_t\ K_t\ L_t\ AGE_t\ AGM_t\ POPGR_t\ CC_t\ SECI_t$ …….....(9)

After linearizing equation (9) and including the error term (t), we arrive at the following estimable econometric model for food security:

$FS_t = \alpha_0 + \alpha_1 AGE_t + \alpha_2 AGM_t + \alpha_3 POPGR_t + \alpha_4 CC_t + \alpha_5 SECI_t + \mu_t$ .....(10)

We propose another equation to explain the relationship between amount of government expenditure and food security in order to account for the endogeneity problem caused by the possibility that government expenditure decisions may be endogenous. Equation (11) models the

relationship between agricultural expenditure (AGE) and food security (FS) as a function of historical food security (FSt-1), agricultural mechanization (AGM), national security (SECI), and population growth rate (POPGR). To account for the placement effect of agricultural expenditure, lagged value of food security (FSt-1,) is incorporated. This is due to the possibility that increased agricultural spending is a reaction to past food security's outstanding performance.

$AGE_t = \alpha_6 + \alpha_7 FS_t + \alpha_8 AGM_t + \alpha_9 POPGR_t + \alpha_{10} FS_{t-1} + \alpha_{11} SECI_t + \mu_{t1}$.....(11)

Results

Table 1: Phillip Perron Unit Root Test Result

Null Hypothesis: Unit root (individual unit root process)
Series: FS, AGE, AGM, CC, POPGR, SECI

Method	Statistic	Prob.**
PP - Fisher Chi-square	89.6293	0.0000
PP - Choi Z-stat	-7.90228	0.0000

Intermediate Phillips-Perron test results]

Series	Prob.	Bandwidth	Obs
D(FS)	0.0001	47.0	167
D(AGE)	0.0054	18.0	163
D(AGM)	0.0007	23.0	167
D(CC)	0.0021	18.0	167
D(POPGR)	0.0001	5.0	167
D(SECI)	0.0008	16.0	167

Source: Author's Computation

The result of Phillip Perron unit root test in table 1, showed that all the variables are integrated of order one i.e. I(1); thus, they are stationary at first differences. This justifies the more our usage of least squares method for analysis of our data considering their same order of integration.

Table 2 Test of Endogeneity Result

Specification: FS AGE AGM CC POPGR SECI C
Instrument specification: C AGE AGM CC POPGR SECI
Endogenous variables to treat as exogenous: AGE POPGR SECI

J-statistic summary:

	Value
Restricted J-statistic	0.000000
Unrestricted J-statistic	3.73E-38

Source: Author's Computation

Result in table 2 indicated the presence of endogeneity in our repressors. This validates the assumed endogeneity problem in our model which we made case of in section three, and has justified the use of two stage least squares as the most suitable method for the analysis of our data to cater for the identified endogeneity problem (Gujarati, 2013).

Table 3: Two Stage Least Squares Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
AGE	0.089958	0.016964	5.302840	0.0000
AGM	-4.435507	2.023085	-2.192447	0.0298
CC	10.82873	2.629646	4.117942	0.0001
POPGR	9.716255	5.847921	1.661489	0.0986
SECI	10.61983	1.017324	10.43899	0.0000
C	-8.603425	16.54484	-0.520006	0.6038

R-squared	0.911078	Mean dependent var	65.72573
Adjusted R-squared	0.908281	S.D. dependent var	26.82051
S.E. of regression	8.122619	Sum squared resid	10490.33
F-statistic	325.8150	Durbin-Watson stat	0.060692
Prob(F-statistic)	0.000000	Second-Stage SSR	10490.33
J-statistic	0.000000	Instrument rank	6

Source: Author's Computation

Our result in table 3 showed that Agricultural Sector Expenditure (AGE), Security Index (SECI) and Climate Change (CC) are the major determinant factors for food security in Nigeria. The regression coefficient of Agriculture Expenditure (0.1) indicated that one unit increase in

agriculture expenditure will approximately lead to 10 percent increase in food security. This is consistent with Maputo's demand that African nations allocate 10% of their annual budgets to the agricultural sector (Maputo, 2003). This demonstrates that in order to increase the agricultural sector's positive influence, which is already evident from our findings, the budgetary allocation to agriculture sector needs to be adjusted upward in Nigeria, so as to achieve food security. The main obstacle to obtaining the highest level of agricultural output in Nigeria has been identified as lack of improved agricultural inputs to farmers at reasonable costs. Therefore, the goal of Nigerian policy would be to boost productivity by ensuring that inputs are timely, of high quality, and competitively priced (FMARD, 2016).

The Climate Change (CC) regression coefficient of 10.8 showed that climate change influences food security by 106 percent in every unit of its variation in Nigeria. This is an indication of substantial effect of climatic weather condition on agricultural productivity.

In terms of rainfall, Nigeria's climate is becoming more unpredictable. The years saw more and more precipitation peaks. Nigeria’s entire vegetative zone is affected by these changing temperature trends. Farmers and herders have clashed throughout the nation as a result of this ongoing desertification, which has driven the majority of herders from the northern region to the southern region. Farmers that use the wet plain around the Niger and Benue Rivers are impacted by the latest flooding issue in Nigeria. Numerous food crops have frequently been flooded and harmed by flooding. The seasonal pattern of food supply has been impacted by this. Because of climate-related incidents, some food items frequently cannot be arrived early (Ani, Anyika, & Mutambara, 2022).

The Agricultural Machine (AGM) regression coefficient's (-4.44) negative sign indicates that Nigeria's current level of farm mechanization is too minimal to contribute to improvements in agricultural productivity and food security. Accordingly, the poor level of agricultural mechanization is having a negative influence on Nigeria's food security, contrary to what was a priori expected.

According to our findings in Table 3, even if the population growth rate has a beneficial effect on food security, the effect is minimal. The government's neglect of the industry may be to blame for agriculture's lack of appeal to the thronging populace. As a result, in Nigeria, farming is primarily carried out by rural residents, who are typically older and poorer women. Another element to take into account in the situation of our huge population's inadequate contribution to guaranteeing high agricultural production,, which is the cornerstone of food security, is the high rate of rural-urban drift.

Finally, with a positive value of the regression coefficient of 10.6, our findings demonstrated a direct correlation between the security index and food security. This explains why Nigeria's very low rates of food production index, which is used in this study as a measure of food security, are caused by the low security index.

Conclusion and Recommendation

Policy makers have disagreed over the years as to whether or not increasing government expenditure in the agricultural sector may promote agricultural production and food security. The argument for larger government spending is that by providing agro-infrastructures, private investors will be drawn to the agricultural sector, stimulating the growth of agricultural value chains and the production of more agricultural goods for local consumption. Additionally, they contend that higher government funding will boost access to improved seed and seedling kinds, resulting in higher yields and overall productivity and expanding food access.

On the other hand, those who favour cutting back on government spending in the agricultural sector contend that farming is a business that should be kept in the hands of the farmers alone, risks and financial investments in infrastructure notwithstanding. They are also sceptical that, in contrast to other economic sectors, expenditure in agriculture will not likely result in increased concrete returns on investment. So, without increasing expenditure, food security might be attained.

In light of this, our study looks at the linkage effect of agriculture expenditure on food security in Nigeria from 1981 to 2022. The conclusion of this paper shows that climate change and agriculture sector expenditure both significantly improved food security in Nigeria.

Based on the study's findings, we advise the government to boost the budgetary allocation to the agricultural sector in order to comply with Maputo 2003's recommendations. The increased spending should also be wisely allocated toward the purchase of agricultural inputs and infrastructure.

Again, growing tree crops and engaging in dry season farming should promote the adoption of climate smart agriculture practices. This will aid in reducing the harmful effects of seasonal flooding and the emission of greenhouse gases.

Additionally, the private sector needs to be involved in promoting the use of renewable energy in agriculture, and the government should raise awareness among the general public and stakeholders about climate smart agriculture.

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