EMPIRICAL ANALYSIS OF THE DETERMINANTS OF FOOD SECURITY IN NIGERIA

By

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Abstract

Ensuring food security is essential for meeting fundamental human needs, maintaining economic stability, and fostering social harmony. Food insecurity contributes to malnutrition, economic difficulties, social instability, and hinders poverty alleviation. Hence, the purpose of this study is to examine the determinants of food security in Nigeria by utilizing annual data from 1991 to 2022 and employing an autoregressive distributed lag (ARDL) modeling approach. Specifically, this study considered the effects of labor input (measured using employment in the agricultural sector), capital input (measured using gross capital formation), bank loan (measured using bank lending to agricultural sector), environmental quality (measured using carbon dioxide emissions per capita), and oil revenue (measured in billion Naira). The findings indicate that all the variables, excluding oil revenue, significantly impact food security in Nigeria especially in the long-run. Consequently, the study offers recommendations, including enhancements of agricultural labor policies, promotion of domestic capital investment, facilitation of accessible bank loans for agriculture, implementation of environmental conservation measures, and diversification of revenue sources away from oil. These measures aim to strengthen the agricultural sector and ensure a more resilient and sustainable food security in Nigeria.

Keywords: Food Security, Labor input, Capital input, Bank loan, Environmental quality.
JEL Codes: H10, K30, L15

1. Background to the Study

Food security is a measure of food availability, accessibility, affordability and utilization. The Rome Declaration on World Food Security defines it as food that is available at all times, to which all persons have means of access; which is nutritionally adequate in terms of quantity, quality and variety, and is acceptable within the given culture (Clover, 2013). It is when all people, at all times, have physical, social and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life (FAO, 2017). Food security plays an important role in the existence of human, needed for healthy living, labour and economic productivity (Agboola, 2014). Lack of ensuring food security is tantamount to political instability, hunger, malnourishment, and reliance of food importation and its adverse effects on trade deficits (Havas & Salman, 2011). Food security can be used to measure development of a country's agricultural sector. It is expected that every country should be able to

feed itself. Thus, when an agricultural sector is able to provide quality food at affordable price, it is said to have developed.

Unfortunately, food security is not a feature of all economies. This is because it is a common problem among several developing countries. These countries lack affordable and quality food (Fawole, et al., 2015). Such countries are not always able to meet the 2250 kcal calorie intake per adult per day, as recommend by the World Health Organization. Report from the United Nations (2020) shows that about 805 million people are undernourished as of 2020; and many of these persons are from developing countries. Between 2010 and 2020, an estimate of 920 million persons were undernourished: 11 million of them were from developed countries, 30 million are from emerging countries, and 799 million are from developing world (Food and Agricultural Organization, 2021).

In Nigeria, the situation is escalating. The average daily per capita of calorie intake in Nigeria has been on the decline, dropping from 140 in 1992 to 37 in 2013, and was 42 in 2022 (World Development Indicators, 2022). Fawole, et al. (2021) noted that prevalence of food insecurity in Nigeria increased from 9% in 2010 to 11% by the end of 2020. These statistics suggest that there has been low agricultural productivity in the country. Therefore, this study investigates determinants of food security in Nigeria. To achieve this, the study is organized into 5 sections. Section 1 is introduction. Section 2 literature review. Section 3 is methodology. Section 4 is empirical analysis and discussion of findings. Section 5 is conclusion and recommendations.

2. Literature Review

2.1 Conceptual Review

2.1.1 Concept of Food Security

There are various definitions of food Security all basically bringing out the same concept. For instance, the definition adopted by countries that attended the world food summit of 1996, is a situation where “all people at all times have both physical and economic access to sufficient, safe and nutritious food to meet their dietary needs and food preferences for an active healthy life” (FAO, 2012). Food security was further segregated into supply side factors and demand side factors all affect security and insecurity of food globally. Some of these factors determine food availability, food accessibility, food stability and also food utilization. Moreover, foods insecurity may be chronic or transitory. It is transitory when a temporary loss of access to adequate food due to perhaps such factors as poor harvest in one season, short time political instabilities, and intra-seasonal price increases occurred. It is known as chronic when a prolonged loss of access to

sufficient food possibly due to prolonged war, enduring harsh environmental conditions and cumulative (uncorrected) bad agricultural policies.

According to Von et al. (1992) food security is both determined by access and availability of food. They are of the view that, food availability does not guarantee food accessibility, while its accessibility is depending on its availability. Along the same reasoning, Dayo and Philip, (1990) pointed out that production of adequate food does not guarantee access to adequate food per capita. This problem relates more to distribution and purchasing power. If a person does not produce his own food and is cash poor, then his purchasing power is rated low and so also his access to food. This is the logical link between poverty and food security. Therefore, local, regional or national availability of food is a function of domestic food production, stock holding and trading.

2.2. Theoretical Review

The theory underpinning for this study is the dual theory by Arthur Lewis. British Economist, Arthur Lewis (1915-1991) developed a dual sector theory in 1954 to explain the importance of developing the agricultural sector for economic prosperity. The theory applies mostly to developing countries like Nigeria, which have agriculturallyabundant resources that have not been optimally developed and a large underutilized population. Earlier in literature, an eighteenth-century school of thought known as the physiocrat ideology propounded that agriculture is the only sector that drives economic prosperity because it produces the net surplus that can promote growth and development. This school of thought comprises of scholars such as Francois Quesnay, Anne-Robert-Jacques Turgot, Marquis de Mirabeau, Marshal Vauban, and Richard Cantillon. The school of thought did not provide a concise explanation how the net surplus will be achieved. Arthur Lewis theory provided basis to understand how this net surplus can be achieved, when it recognized the need for introduction of surplus labour from an informal, less developed agricultural sector, to a well-developed but labour deficit agricultural sector). This would help increase marginal productivity of labour, raise their income level and standard of living, and bring about inclusive growth of the economy.

2.3. Empirical Review

Studies have examined the determinants of food security in different regions. Anila and Adiqa (2019) examined the determinants of food security at household level done in Pakistan using a logistic regression procedure. Five different variables are employed out of other different demographic indicators that can scrutinize food security. These among others are: residence,

dependencies, general capital, status of their employments and their educational attainment level especially of the family head. The study shows that place of residence (especially urban) is having a significant and negative impact on household's food security status. Level of dependency ratio has also a significant effect on their food security and is similar to a-priori. Educational level attained of the head beyond intermediate stage has again significant and positive effect on food security. Moreover, employment and social capital didn't affect household's food security at all.

Ana, Bill and Sekher (2019) examined the determinants of food security in rural India. They employed probit and ordered probit models to analyze the determinants of food security in rural India. They made use of household full assets, ownership of land, food safety access of the residents of the area under study, the study got a strong evidence to depict that revenue from farm, poverty, beliefs and area heterogeneity all influence food security of households. Seydou, Liu and Baohui (2020) investigated the variable affecting the household food security in Niger Republic. In the study, 500 house owners were examined, disasters, rising food prices, impoverishment, bad soil, diseases and pest attack are recorded by the interviewees to be the first cause of food insecurity. Empirical results of logistic regression showed that gender of household head, major diseases, pests, labor flooding, impoverishing, market access, the proximity away from the major way and food support or food aid are all significant factors that influence the problem of a house owner having adequate daily intakes. The result of this study depicted evidence showing food insecurity rising to affect the Niger republic populace.

Jean (2021) made use of probit method to show determinants of food insecurity among all rural households of Rwanda. The empirical evidences showed that rural dwellers are exposed to food insecurity when compared to their urban counterparts. This research showed significant factors to clearly verify changes in rural dwellers food insecurity as; size of household, farm animals of household, assets of household index, food acquisition level of household, food acquisition problem of household, spending level of household, food expenditure on monthly basis and land fertility.

Tamara, Emily and Areej (2015) examined the determinants of food insecurity and the weight of health issues on social issues in Urban Population of Youth. Sick patients ages ranging from 15-25 years of age finished a web-based filtering tool. Validated ways of questioning were used so as to identify all issues in 7 health-related social areas, namely insecurity of, access to healthcare, level of education, housing of household, household's income insecurity, use of substance, then intimate domestic violence. Kruskal-Wallis, Chi-square tests and logistic regression models controlled for sex, age, ethnicity/race, analysed the relationship between food insecurity and healthcare-related problems. Predicting values of a two-item food insecurity were

used side by side with the US department of Agriculture and food security survey were analysed. The research found that one of three of the youths in the sample drawn experience food insecurity, that was associated with the existence of some health accompanied social issues. Food insecurity ways of screening can take us to identify other health accompanied social issues that when handled early may improve health of most adolescents.

Mathewos and Nigatu (2016) analysed livelihood diversifying under abject food insecurity among small farmers in southern Ethiopia. This cross-sectional research analysed the level of livelihood diversifying and the impacts of socio demographic issues in dire food insecurity among small farmers in the Kadida Gamela district, southern Ethiopia. Data used were gotten from two hundred households, by simple random sampling technique. They made use Barger-Parker Diversity and the Simpson index to evaluate the level of livelihood diversifying and OLS to measure determinants of livelihood diversifying. However, 65 percent of households found engaging in 2 to 3 livelihood sources. The final results of this analysis showed that level of education of the head of house, credit access, food for work programme participation and the size of land owned by households were all the key predictors of livelihood diversification in food security.

Nuruddeen (2019) examined food security and vulnerability in drought prone northern states in Nigeria. He made use of descriptive survey to measure socio-economic and demographic data of some households, since regression analysis was made use of to measure the food security and insecurity status of households by using World and Nigerian levels provided by the FAO. Final result of this study showed that size of household, education attained as well as per capita incomes depicted strong effects on food security status in the study region.

Abdullahi, Hassan and Ayanlere (2020) studied determinants of food security status among some rural farming households in North-western Nigeria, made use of logit regression model. This research showed that individual age, contact extension, labour sources and per capita income were main determinants of food security in the study region. The end results of merged impact also showed that food security among the households is responsive to a change in age of household than that of elongated contact, labour sources and then per capita income.

At country wide level, Babatunde, Omotesho and Sholotan (2017), studied the socio-economic features and food security status of farming household in Kwara state Nigeria. They made use of logit regression model. The research showed that socio economic factors of the households are very essential determinants of food security or insecurity status. This research depicted household's revenue, food quantity from own production, household's education and household's size all are important determinants of food security among rural households.

Moreover, it also showed that head of household education attained is a significant determinants of food security.

A study carried out in Kwara State on food security and the marketing of maize in Nigeria by Babatunde and Eniola (2018) supports the above conclusion that, middle men gain at the expense of farmers who are the main producers. As revealed by a field survey, this development is as a result of transportation problem, insufficient market structures, insufficient funding for food marketing, and the shortage of storage facilities, seasonality and perishability of farm food produce. Therefore, for food domestic production to rise then enhance the prospect of food security in the country, there should be improvement in infrastructure, marketing facilities such as storage facilities and high-level investment in the post-harvest technology research and then development.

The literature gap identified in previous studies is the omission of environmental quality considerations resulting from climate change, particularly the increase in carbon emissions. This study aims to address this gap by incorporating carbon emission as one of the determinants in assessing food security in Nigeria.

3. Methodology

The study made use of descriptive and inferential techniques to examine the determinants of food securityin Nigeria. In this context, the study collected secondary data with a view to statistically analyse it and generalize the results to food security situation in Nigeria. Specifically, this study employed these designs which are concerned with determining the existence of statistical relationship(s) between two or more variables through developing a theoretical framework. Datawas sourced mainly from the Central Bank of Nigeria (CBN) statistical bulletins (various issues) and Food and Agricultural organization (FAO).

3.1 Model Specification

This study adopts a Cobb–Douglas production function to capture the effects of capital and labour on agricultural productivity. The Cobb–Douglas production function is stated mathematically as:

$$Y = AL^{\alpha}K^{\beta} \quad (1)$$

Where: Y = total output, L = labour input K = capital input A = total factor productivity α and β are the output elasticities of labor and capital respectively. Equation (1) is adjusted for the sake of

this study and food security is used to replace total output. Following Obiakor et al. (2022), labour input, capital input and other determinants of food security augmented Cobb-Doglas production function from the basic of our model, which is specified in equation (2).

$$FSEC_t = f(LAB_t, CAP_t, LOAN_t, ENV_t, REV_t) \quad (2)$$

In equation (2) SEC is food security (proxied using food production index) LAB is Labour input (employment rate in the agricultural sector) CAP is Capital input (measured by gross fixed capital formation) Loan is agricultural loan (proxied using bank lending to agriculture) ENV is environmental pollution (measured using carbon dioxide emission) REV is Oil revenue.Expressing equation (2) in logarithmic form yields the econometric model of the study as represented in equation (3).

$$lnFSEC_t = \alpha_0 + \alpha_1 lnLAB_t + \alpha_2 lnCAP_t + \alpha_3 lnLOAN_t + \alpha_4 lnENV_t + \alpha_5 lnREV_t + \epsilon_t \quad (3)$$

In equation (3) ln is natural logarithm, $\alpha_0$is constant or intercept and is the stochastic error termϵ_t; $\alpha 1$, $\alpha 2$, $\alpha 3$, $\alpha 4$, and $\alpha 5$ are the coefficients associated with the respective independent variables (LAB, CAP, LOAN, ENV, REV). These coefficients represent the expected change *FSECt* for a one-unit change in the corresponding independent variable, holding other variables constant.

3.2 Estimation Technique

This study adopts Autoregressive Distributed Lag modelling-ARDL (Bounds test) approach to co-integration as advanced by Peasaran, et al. (2001). The superiority of ARDL over other co-integration techniques is that, it does not enforce restraint on the integration order of the series; whether being all I(1) or I(0). Therefore, the ARDL can be employed irrespective of whether the series are all I(0), I(1) or jointly co-integrated (Pesaran et al., 2001). This approach also overcome the problem related to omitted variables and autocorrelations, as well as provide unbiased and efficient estimates and valid t-statistics even when there is endogeneity (Narayan 2004; Odhiambo, 2010). For the ARDL test, the following restricted error correction models were estimated:

$$\Delta ln(FSEC)_t = \alpha_0 + \alpha_1 ln(FSEC)_{t-1} + \alpha_2 ln(LAB)_{t-1} + \alpha_3 ln(CAP)_{t-1} + \alpha_4 ln(LOAN)_{t-1} + \alpha_5 ln(ENV)_{t-1} + \alpha_6 ln(REV)_{t-1} + \sum_{1=1}^{p} \beta_1 \Delta ln(FSEC)_{t-1} + \sum_{1=0}^{q} \beta_2 \Delta ln(LAB)_{t-1} + \sum_{1=0}^{q} \beta_3 \Delta ln(CAP)_{t-1} + \sum_{1=0}^{q} \beta_4 \Delta ln(LOAN)_{t-1} + \sum_{1=0}^{q} \beta_5 \Delta ln(ENV)_{t-1} + \sum_{1=0}^{q} \beta_6 \Delta ln(REV)_{t-1} + \epsilon_t \quad (4)$$

The ARDL bounds F-test was conducted to established the existence of co-integration or long run relationship among food security proxies by per calorie intake and its respective determinants. The tests involve the following null hypothesis: H_0: $\alpha_1=\alpha_2=\alpha_3=\alpha_4=\alpha_5=\alpha_6=\alpha_4=0$. The decision rule is, if the calculated F-statistic values are greater than the upper bound critical F-statistic then there is co-integration, while if it is below the lower critical bound F-statistic there is no co-integration. On the other hand, if the value falls between the lower and upper critical bounds, then the test is inconclusive. Having established the existence of long run relationship using the ARDL procedure, the parameters of the short-run model are computed as given in the following models:

$$\Delta \ln (FSEC)_t = \alpha_0 + \sum_{1=1}^{p} \beta_1 \Delta ln(FSEC)_{t-1} + \sum_{1=0}^{q} \beta_2 \Delta ln(LAB)_{t-1} + \sum_{1=0}^{q} \beta_3 \Delta ln(CAP)_{t-1} + \sum_{1=0}^{q} \beta_4 \Delta ln(LOAN)_{t-1} + \sum_{1=0}^{q} \beta_5 \Delta ln(ENV)_{t-1} + \sum_{1=0}^{q} \beta_6 \Delta ln(REV)_{t-1} + ECT_{t-1} + \varepsilon_t \quad (5)$$

Equation (5) are utilized to analyse the short run dynamics of the models as well as the error correction mechanism, which shows the extent to which short run shocks are adjusted to the long run equilibrium path.

4. Results and Discussion

4.1 Results of the Unit Root Tests

This study employed Augmented Dickey-Fuller (ADF) and Philips-Peron (PP) unit root tests to check the stationary properties of the series and the results of the tests are presented in Table 1.

Table 1: Results of ADF and PP Unit Root Tests

	ADF		PP		
Variables	Level	First Difference	Level	First Difference	Stationary Status
LnFSEC	-2.795	-11.927***	-0.856	-13.059***	I(1)
LnLAB	-3.526**	-3.826***	-3.169**		I(0)
LnCAP	-2.371	-2.607*	-1.781	-5.706***	I(1)
LnLOAN	-2.249	-5.713***	-2.377	-5.620***	I(1)
LnENV	-2.398	-5.151***	-2.176	-5.443***	I(1)
LnREV	-2.059	-4.224***	-1.894	-3.391*	I(1)

Notes: ***' ** and * denote significance at 1%, 5% and 10% respectively. Lag length are selected based on SIC.
Source: Researcher's computation (2024)

The results of ADF and PP unit root tests presented in table 4.3 revealed that, all the variables except lnLAB have unit root at their levels, which means they are not stationary. After taking the first difference, the variables became stationary, hence, they are integrated of order one [*I(1)*]. Since the results of unit root tests showed a mixture of integration order, therefore, the utilization of ARDL is justified in this situation as it can accommodate variables with both stationary at level (I(0)) and stationary at first difference (I(1)).

4.2. Results of ARDL Bounds Test for Co-integration

Following the unit root tests conducted in the previous section, we now move on to examine the presence of co-integration (long-run) relationship among the variables using bounds tests for linear ARDL model. This test is crucial in determining whether a long-run relationship exists among the variables in the model. The empirical result of the bounds test for co-integration are reported in Table 2.

Table 2: Results of Bound Tests for ARDL Model

		Critical values at 5%		
Model	F-statistics	Lower bound	Upper bound	Co-integration Status
$FSEC_t = f(LAB_t, CAP_t, LOAN_t, ENV_t, REV_t)$	6.702	3.47	4.57	Co-integration

Source: Researcher's computation (2024)

The result in Table 2 of the ARDL co-integration test show the following statistics: The F-statistics represent the test statistics for co-integration, which are used to assess whether there is a significant long-run relationship among the variables in the model. Lower bound and Upper bound: These values represent the critical values at the 5% significance level. The bounds are

used to determine whether the F-statistics fall within the range of no co-integration or co-integration. Co-integration Status: This indicates whether co-integration is present or not based on the comparison of the F-statistics with the critical values. The result shows the F-statistics for the model is 6.702. Comparing it with the lower bound of 3.47 and the upper bound of 4.57, we find that the F-statistics is above the upper bound. This suggests the presence of co-integration in the model. After confirming the long-run relationship among the variables in the model, the step involves estimating the effect of the determinants of food security in Nigeria. The coefficients of the long-run and short-run derived from the estimation of the model are presented in Table 3.

Table 3: Results of Estimated Coefficients of the Long-run and Short-run

Panel A: Long-run Coefficients - Dependent variable is FSEC				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
lnLAB	0.935	0.437	2.139	0.039
lnCAP	7.521	2.343	3.210	0.003
lnLOAN	1.244	0.591	2.105	0.042
lnENV	-0.942	0.438	-2.140	0.040
lnREV	2.511	5.353	0.469	0.345
C	1.386	0.107	12.912	0.000
Panel B: Short-run Coefficients - Dependent variable is ΔFSEC				
ΔlnCAP	6.145	2.738	2.244	0.031
ECT_{t_1}	-0.733	0.124	-5.895	0.000
R2	0.799			
Adjusted R2	0.7564			
F-stat	5.911			0.000

Note: Akaike Information Criterion (AIC) is used to select the optimal lags (1, 0, 1, 0, 0, 0)

The presented result in Table 3, Panel A, offer crucial insights into the long-run relationships between key variables and the food security (lnFSEC). Firstly, the coefficient for labour input (lnLAB) is 0.935, indicating that an increase in labour input is associated with a corresponding increase in the long-run level of the food security (lnFSEC). Specifically, a 1% increase in labour input will leads to 0.94% increase in food security. The statistically significant t-statistic of 2.139 emphasizes the robustness and reliability of this relationship. Similarly, the coefficient for capital

input (lnCAP) is 7.52. Specifically, a 1% increase in capital input will leads to 7.52% increase in food security. These findings align with the initial expectations and are in harmony with the results obtained by Harswari et al. (2017), Utile et al. (2018), and Matarr and Momodou (2021), who similarly identified a significant impact of labour and capital inputs on food security.

Similarly, the results also show that an increase in bank loans is associated with a corresponding increase in the long-run level of food security (lnFSEC). Specifically, a 1% increase in bank loans leads to a 1.24% increase in food security. The statistically significant t-statistic of 2.105 emphasizes the robustness and reliability of this relationship. This suggests that facilitating access to bank loans in the agricultural sector can have a positive impact on food security, possibly by promoting investments and productivity. However, A decrease in environmental quality (i.e. increase in carbon emission) is associated with a corresponding decrease in the long-run level of food security (lnFSEC). Specifically, a 1% decrease in environmental quality leads to a 0.94% decrease in food security. This highlights the adverse impact of environmental degradation, as measured by carbon emissions, on food security. Environmental conservation measures are crucial to sustaining food security. Moreover, the coefficient of oil revenue (2.511) is positive, but not statistically significant (t-statistic of 0.469). The lack of statistical significance indicates uncertainty regarding the impact of oil revenue on food security in Nigeria. This may be due the fact that oil revenue is allocated nationally and the allocation coming to agricultural sector may have been the reason behind the insignificance.

5. Conclusion and Recommendations

This study extensively investigated the determinants of food security in Nigeria over the period from 1991 to 2022, utilizing an autoregressive distributed lag (ARDL) modeling approach. The analysis considered key variables such as labor input, capital input, bank loans, environmental quality, and oil revenue. The results revealed that, with the exception of oil revenue, all other variables significantly influence food security in Nigeria, particularly in the long run. This suggests that policies addressing these determinants could have a substantial impact on enhancing food security in the country.

Based on the study's findings, several recommendations are proposed to improve food security in Nigeria: Improve Agricultural Labor Policies: Enhance policies related to labor in the agricultural sector, focusing on skill development, increased employment opportunities, and the well-being of agricultural workers. Promote Domestic Capital Investment: Encourage and promote investments in the agricultural sector by both private and public entities through

incentives and initiatives. Implement Environmental Conservation Measures: Enact robust environmental conservation measures, including regulations and incentives for sustainable practices in the agricultural sector. Diversify Revenue Sources Away from Oil: Reduce dependence on oil revenue by exploring alternative income streams, supporting non-oil industries, and promoting sustainable agricultural practices.

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