THE IMPACT OF PALM OIL PRODUCTION ON THE NIGERIAN AGRICULTURAL SECTOR (1990 - 2020)

*Dada, M, *Abdul-Qadir, M.I., **Sulaiman-IIobu, B.B., *Garba, I.D., and *Bankole, A.S.

*Agricultural Economics Division, Nigerian Institute for Oil Palm Research (NIFOR), Benin City, Edo State, Nigeria.
**Department of Agriculture Biotechnology, National Biotechnology Development Agency, Abuja

ABSTRACT

Oil palm is considered vital to the global economy, hence, the impact of palm oil production on Nigeria's agricultural sector has become very crucial. Therefore, there is a need to understand the opportunities and challenges associated with palm oil production and its impact on the Nigerian economy. This study, however, investigates the impact of palm oil production on Nigeria's agricultural sector from 1990 to 2020 using time series data. The analysis focuses on key variables including public finance and grants to the palm oil industry (PFG), palm oil output (POQ), bank credit (BC), and agricultural output (GDP). After subjecting these variables to unit root tests, they were found to be stationary at first difference. A co-integration test confirmed a long-term relationship at the 5% significance level. The study employs an Error Correction Model (ECM), complemented by diagnostic tests such as the LM test, Ramsey's RESET test, and a normality test. Results reveal that palm oil output positively and significantly influences agricultural output, while public finance and grants to the palm oil industry have a positive and significant impact on palm oil production. Based on these findings, the study recommends promoting exports and formulating export promotion policies to enhance market interactions for palm oil, thereby encouraging farmers to increase their output.

Keywords: Error Correction Model (ECM), Output, palm Oil Production

INTRODUCTION

The oil palm (*Elaeis guineensis*) is a pivotal fruit crop and the foremost vegetable oil crop globally. Palm oil is extracted from the fruit of oil palm and is a significant commodity in international markets, utilized widely as both a food ingredient and a raw material (O'Brien, 2008). This crop is integral to the global economy, thriving in the tropical regions of Africa, Asia, and Latin America. Its versatility ensures that palm oil and its derivatives are present in approximately 50% of all packaged products found in supermarkets worldwide, spanning foodstuffs, cosmetics, pharmaceuticals, household cleaners, and biodiesel (Murphy et al., 2012). In Nigeria, the oil palm industry is not only a critical economic sector but also a source of livelihood for millions, especially in the southern part of the country, which is rich in forests, watersheds, and biodiversity. Historically, the Nigerian palm oil industry was a major component of the country's agricultural export sector. Before the 1970s oil boom, agricultural products, including palm oil, cocoa, rubber, and cotton, constituted 70% of Nigeria's foreign earnings. The discovery and exploitation of crude oil in the 1970s shifted the nation's economic reliance towards petroleum, diminishing the role of agriculture in revenue generation and economic growth.

The Nigerian palm oil industry has experienced considerable transformation, marked by stagnation in domestic production and a reduced share in the global market. In the 1960s, Nigeria was the world's leading producer of palm oil, holding a 43% market share. However, this share has dwindled to approximately 2.9% in recent years, with Indonesia now leading production with 33 million metric tons, followed by Malaysia at 19.8 million metric tons, Thailand at 2 million metric tons, Colombia at 1.108 million metric tons, and Nigeria at 970,000 metric tons (PWC, 2019). As of 2017, palm oil is cultivated in 15 out of Nigeria's 36 states (Abia, Anambra, Bayelsa, Akwa Ibom, Cross River, Delta, Ebonyi, Edo, Ekiti, Enugu, Ondo, Ogun, Osun, Oyo, Imo, and Rivers), covering just over 3 million hectares. Despite the potential, the ideal land available for oil palm cultivation is estimated at 24 million hectares (Dada, 2017). Approximately 80% of palm oil production comes from smallholdings dispersed across an estimated 1.6 to 2.4 million hectares (Dada, 2007; Kajisa, Maredia & Boughton, 1997), while estate plantations cover only about 169,000 to 360,000 hectares, with significant growth in the last decade due to private sector investment (Egwuma, H et al 2016). In 2017, the area harvested for palm oil was around 3.2 million hectares, but production was limited to 930,000 metric tons (Dada, 2017).

The primary objective of this study is to analyze the impact of the palm oil sector on the Nigerian economy from 1990 to 2020. Recent research has increasingly focused on the role of non-oil exports in economic growth, particularly in developing countries. Several studies have explored this area, including those by Uche (2009), Onwueiribi and Okpokiri (2015), Adeyomi (2015), Zakari et al. (2016), and Egwuma et al. (2016). Uche (2009) utilized econometric methods to examine the impact of palm oil exports on Nigeria's economic growth and found a unidirectional causality from palm oil exports to GDP, supporting the notion of export-led growth in Nigeria. Onwueiribi and Okpokiri (2015) and Adeyomi (2015) investigated the determinants of palm oil production and concluded that inflation rates and income levels significantly influence both import and domestic demand for palm oil in Nigeria. However, most studies reviewed have not examined the link between palm oil sector and the role of credit on palm oil production. This study will contribute to the existing body of knowledge by providing credible and actionable policy recommendations to address current gaps and enhance the performance of the palm oil sector. It will serve as a valuable resource for future researchers and a guide for stakeholders in the palm oil industry. Additionally, the findings will underscore the critical role of government in supporting the non-oil sector and highlight the potential benefits of investing in this area. This study aims to investigate the impact of palm oil production on Nigeria's agricultural sector. Specifically, it seeks to understand the opportunities and challenges associated with palm oil production and its implications for the Nigerian economy. By evaluating these factors, the study intends to provide a comprehensive assessment of how palm oil production affects the agricultural sector.

METHODOLOGY

The research was empirical and employed the Error Correction Model (ECM) to examine the impact of palm oil production on Nigeria's agricultural sector. This approach allows for a detailed analysis of the interactions among macroeconomic variables. Initially, a stationarity test (unit root test) was be conducted using the Phillips-Perron test to ensure the variables are stationary and to avoid spurious regression, as recommended by Granger and Newbold (1974). Should the variables prove non-stationary, a cointegration test was performed as a pre-test for spurious regression. The Johansen cointegration test was utilized to identify long-run relationships among the variables. Additionally, the Augmented Engle-Granger cointegration test was conducted to confirm the model's suitability for analyzing the impact of palm oil production on the Nigerian economy. The empirical analysis adopted a model based on Adeyemi (2015), who investigated the determinants of palm oil in Nigeria from 1971 to 2010. The model is specified as follows:

LQ = f (LP, LAB, FIN) (1)

Where:

LQ = Palm oil output

LP = Real World Market Price for palm oil

FIN = Finance

The model is modified to include other variables that are pertinent to the objective of the study such agricultural output. ECM models come into to play when it has been established that, there exist a long-run relationship between the variables under consideration. The ECM regression equation is given below as:

$$\Delta AGQ = \beta\_0 + \beta\_1\, \Delta POQ + \beta\_2\, \Delta BC + \beta\_3\, \Delta PFG + \rho ECM(-1) + Ut \qquad (2)$$

Where:

AGQ is Agricultural Output

BC is Bank Credit

POQ is Palm Oil Output

PFG is Public Financing and Grants to the palm oil industry

α0, β0 and λ0 are constant parameters,

α1 – α4, β1 – β3, λ1 – λ2 are Coefficients to be estimated,

Ut is the Gaussian white noise that are independently and identically distributed random variable. A significant and negative coefficient for the ECM term (\(\rho\)) indicates that short-term deviations between the independent and dependent variables lead to a stable long-run relationship. Agricultural output was measured as the total value of goods produced within the agricultural sector, expressed in billion Naira, while bank credit was measured as the value of funds channeled to the agriculture sector measured in billion Naira.

Data Collection

The research utilized secondary data, specifically Time Series Annual Data, covering the period from 1990 to 2020. Data on bank credit and agricultural output was sourced from the Central Bank of Nigeria Statistical Bulletin (2020), while data on palm oil output was obtained from the World Economic Outlook (2020).

Method of Data Analysis

The ECM was used to establish both long-run and short-run interactions between palm oil production and other macroeconomic variables such as agricultural output and financing in Nigeria. The ECM framework addresses deviations from long-run equilibrium and estimates the speed at which the dependent variable returns to equilibrium following changes in other variables (Granger and Newbold, 1974).

Pre-Estimation Tests

1. Stationarity Test: The stationarity of each variable was assessed using the unit root method, specifically the Augmented Dickey-Fuller (ADF) test. An autoregressive model (AR(1) process) will be employed, regressing each variable on its lagged value without an intercept or deterministic trend. Autocorrelation in the error term will be addressed by the ADF test. The model used is:

$$\Delta Yt = \delta Yt - 1 + \mu t \qquad (3)$$

δ=ρ-1

Where; Y represents all the variables under consideration; δ represents the coefficient of the lagged value of Y; Δ is the first difference operator; Yt-i represents the lagged terms included; μt represents pure white noise error term.

The null hypothesis tested is such that the variable possess unit root, and as such is non-stationary.

H0 : δ = 0 (ρ = 1) presence of unit root; H0 : δ ≠ 0 (ρ < 1) no unit root

The decision rule will be such that if the absolute ADF statistic is greater than the absolute critical values, the null hypothesis will be rejected.

2. Cointegration Test: The Johansen and Juselius (1990) methodology was used to determine the number of co-integrating vectors through the trace test statistic and the maximum eigenvalue test statistic. The trace statistic tests the null hypothesis that the number of divergent co-integrating relationships is less than or equal to '*r*' against the alternative hypothesis of more than '*r*' co-integrating relationships, and is defined as:

$$\theta_{trace}(r) = -T \sum_{j=r+1}^{P} 1n\left(1-\hat{\theta}_j\right) \qquad (4)$$

The maximum likelihood ratio or the maximum Eigen-value statistic, for testing the null hypothesis of at most 'r' co-integrating vectors against the alternative hypothesis of 'r+l 'co-integrating vectors, is given by:

$$\theta_{\max}(r,r,+1) = -T\,1n\,(1-\hat{\theta}_{r+1}) \quad \theta_{trace}(r) = -T \sum_{j=r+1}^{P} 1n\left(1-\hat{\theta}_j\right) \qquad (5)$$

Where $\hat{\theta}_j$ = the Eigen values, T = total number of observations. Johansen argues that, trace and statistics have nonstandard distributions under the null hypothesis, and provides approximate critical values for the statistic, generated by Monte Carlo methods. In a situation where Trace and Maximum Eigen-value statistics yield different results, the results of trace test should be preferred.

Model Diagnostic Test

It is necessary to check the goodness of fit of the model and the statistical significance of the estimated parameter; the statistical criterion used to check the goodness of fit was the coefficient of determination (R2) and the T-Test, Langrangian multiplier test and F test were the criteria used to check the statistical significance of the estimated parameters.

RESULTS AND DISCUSSION

The results presented here were derived from the tests earlier stated using EViews 9.0 statistical software.

Data Analysis

Table 1 Summary Statistics

	AGO	BC	PFG	POQ
Mean	3587.827	636448.8	18.10400	797.0667
Median	3590.910	674135.0	17.77000	795.0000
Maximum	4394.500	932425.3	24.85000	988.0000
Minimum	3049.300	144160.0	15.14000	570.0000
Std. Dev.	359.7250	195651.9	2.401551	139.5203
Skewness	0.251803	-1.283207	1.455176	-0.124712
Kurtosis	2.487560	4.410932	4.953896	1.756288
Jarque-Bera	0.645269	10.72151	15.35982	2.011291
Probability	0.724239	0.004697	0.000462	0.365808
Sum	107634.8	19093464	543.1200	23912.00
Sum Sq. Dev.	3752660.	1.11E+12	167.2559	564511.9
Observations	**30**	**30**	**30**	**30**

Source: Field Survey

It was observed from the summary statistics with reference to the Jarque Bera estimates and probability value that BC and PFG are not normally distributed due to their low probability values of 0.004697 and 0.000462 respectively which is lower than the probability value of 0.05. From the central limit theorem (CLT) nonnormality does not affect mean values and as such since VECM parameters are mean values, the non-normality of the variables does not affect VECM parameters in the model to be estimated.

On the other hand, it was observed that the probability values for AGQ and POQ were normally distributed due to their high probability value of 0.645269 and 0.365808 which was higher than the probability of 0.05.

Unit Root Test

The Augmented Dickey-Fuller test will be used to test for unit root. All the variables were regressed on trend and intercept to determine if they have a trend, it was discovered that the five variables have trend and intercept, hence the unit root test involves trend and intercept.

Table 2: Unit Root Stationarity Result

Variable	ADF Statistics	Critical Value	Stationary Status
AGQ	-7.460302	-4.26274(1%) -3.55297(5%) -3.20964(10%)	I(1)
PFG	-8.382534	-4.26274(1%) -3.55297 (5%) -3.20964(10%)	I(1)
POQ	-6.009893	-4.26274(1%) -3.55297 (5%) -3.20964(10%)	I(1)
BC	-3.860210	-3.5743 (1%) -2.6920 (5%) -1.2856 (10%)	I(1)

The critical values for rejection of hypothesis of unit root were from MacKinnon (1991) as reported in e-views 9.0.

Source: Field Survey

The five variables (AGQ, PFG, BC and POQ) underwent unit root test using the Augmented Dickey-Fuller (ADF) test. As is the case most times, all three variables were found to be non-stationary at levels. The variables (AGQ, PFG, BC and POQ) were found to be stationary after first difference.

Co-Integration

Table 3 Johansen Co-Integration Test

Date: 01/06/20 Time: 03:22
Sample (adjusted): 1990 2019
Included observations: 29 after adjustments
Trend assumption: Linear deterministic trend
Series: AGQ BC PFG POQ
Lags interval (in first differences): 1 to 1
Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.963619	305.0857	159.5297	0.0000
At most 1 *	0.938099	212.3017	125.6154	0.0000
At most 2 *	0.789378	134.3995	95.75366	0.0000
At most 3 *	0.667567	90.78417	69.81889	0.0005
At most 4 *	0.582308	59.94733	47.85613	0.0025

Trace test indicates 5 cointegrating equations(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values
Source: Field Survey

The table above shows the long run relationship existing among the variables of study. The table shows the variables converge in the long run thereby depicting the existence of long-run relationships among them. The long-run relationship exists at a 5% level of significance according to the Trace test statistics and the Eigenvalue. This implies there exist four (4) co-integrating relationships among the variables. Therefore, there is long-run relationship among the variables.

Granger Causality Test

Table 4 Causality Test

Null Hypothesis (H0)	Chi-Square	Probability	Decision
PFG does not cause AGQ	9.804570	0.0017	Reject Ho
AGQ does not cause PFG	0.081622	0.7751	Accept Ho
POQ does not cause AGQ	2.192594	0.1387	Accept Ho
AGQ does not cause POQ	3.926231	0.0475	Reject Ho
BC does not cause AGQ	0.014697	0.9035	Accept Ho
AGQ does not cause BC	0.624606	0.4293	Accept Ho

Sources: Field Survey

Table 4 is the Granger causality test it illustrates the direction of causality among the variables under study. From Table 4.9, there is a one-way causality between AGQ and PFG and it flows from PFG to AGQ. This indicates that Public Finance and Grants to the palm oil industry Causes Agricultural Output. There is one-way causality between AGQ and POQ and it flows from AGQ to POQ. This means that Agricultural Output causes Palm Oil Output. There is no causality between AGQ and BC.

Table 5 Estimation of ECM for model (Dependent Variable) AGQ

Independent Variables	Coefficient	Standard Error	t-Statistic	Probability
D(POQ)	79.51258	11.97585	66.32394	0.0000
D(PFG)	14.06949	2.301362	6.113551	0.0000
D(BC)	0.000116	0.000035	3.254393	0.0007
ECM2(-1)	-0.872010	0.197062	-4.425043	0.0002
C	7.266518	54.44347	0.133469	0.8949
Model Diagnostics				
R^2	0.551107			
Adjusted R^2	0.539625			
F test	9.93093 (0.000)			
Ramsey RASET	0.01849 (0.9407)			
Normality Test	2.90931 (0.2090)			
LM test	1.20291 (0.3205)			

Source: Field Survey

Table 5 shows that a unit increase in Palm Oil Output (POQ) results in an approximate increase of 79.51258 units in Agricultural Output, holding other variables constant. The positive coefficient for Palm Oil Output aligns with the a priori expectations. The probability value indicates that this impact is statistically significant.

Similarly, a unit increase in Public Finance and Grants (PFG) to the palm oil industry increases approximately 14.06949 units in Agricultural Output, while a unit increase in Bank Credit (BC) leads to an increase of 0.000116 units, with other variables held constant. The positive signs for Public Finance and Grants, as well as Bank Credit, are consistent with expectations, and their significant probability values confirm their impact. The Error Correction Model (ECM) coefficient of -0.872010 suggests that the model adjusts 87 percent of any disequilibrium from the previous period within the current period. Model diagnostics reveal that approximately 55 percent of the variance in Agricultural Output is explained by the independent variables, as indicated by the coefficient of determination (R^2). The F-statistic confirms that the model is significant at the 5 percent level, with a probability value of 0.0000097 (less than 0.05). The Ramsey RESET test indicates that the model is correctly specified, while the LM test shows no serial correlation in the residuals. The Jarque-Bera statistic confirms that the residuals are normally distributed.

The analysis in Table 5 reveals that palm oil output has a positive and significant impact on agricultural output in the long run. This finding aligns with previous research by Baldacci et al. (2003) and Gupta et al. (2002). Similarly, studies by Anand and Ravallion (1993), Day and Tousignant (2005), Cremieux et al. (2005), Kee (2001), and Ogungbenle (2009) also demonstrate a significant impact of palm oil output on agricultural performance. Additionally, the results indicate that bank credit positively and significantly affects agricultural output. This finding is consistent with several studies, including those by Filmier et al. (1999), Geweke et al. (2003), Kesseler and McClellion (2000), McClellan and Noguchi (1998), and Glied and Muney (2003), all of which underscore the significant role of bank credit in enhancing agricultural productivity.

CONCLUSION AND RECOMMENDATIONS

The results clearly demonstrate that agricultural output is significantly influenced by palm oil production. Specifically, its indicators from the palm oil industry—such as public financing, grants, bank credit, and palm oil output—have a substantial impact on both agricultural output within the sector. Based on these findings, the study makes the following recommendations:

1. Promotion of Exports: Develop and implement export promotion policies to enhance market access for palm oil, thereby encouraging farmers to increase their production.

2. Technological Advancements: Encourage farmers and growers to adopt technology-driven production techniques to improve palm oil yield and overall productivity.

3. Industry-Research Collaboration: Foster collaborations between the palm oil industry and research institutions to drive innovation and boost production efficiency.

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