ANALYSIS OF DETERMINANTS OF PALM OIL PRODUCTION IN NIGERIA (1985 – 2018)

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ABSTRACT

Nigeria today produces only 1.7 percent of the world's consumption of palm oil which is sufficient to meet its domestic consumption which stands at 2.7 percent. The production of palm oil in Nigeria has been affected by some factors, this study analyzed the determinants of output supply of palm oil in Nigeria. In addition, the study analyzed the trend and growth in the output supply of palm oil.

The secondary data was used which include time series micro level data spanning from 1971 – 2010. The data was sourced from several of central bank of Nigeria (CBN) statistical bulletin and the statistical database of the Food and Agricultural Organizations of the United Nation. Trend analysis, ADF unit root test, co-integration test and error correction model were used to analyze the data.

The trend in the output supply of palm oil shows significant growth rate based on the coefficient of the time trend. The unit root test using Augmented Dickey Fuller test (ADF) shows that all the variables have constant mean except for palm oil yield which led to the Auto regressive Distributed Lag (ARDL) co-integration test which reveals the presence of long run relationship existing between the variables and short run relationships with error correction term. Imports of palm oil has negative significant short run and long run impacts on the output supply of palm oil while in the short run palm oil exports has a significant negative impact on the palm oil output supply of palm oil negatively as this impedes the local production of palm oil.

This study therefore, recommends the promotion of export and formulation of export promotion policies to stimulate international market for out palm oil and encourage our farmers to boost their output.

In conclusion: the trend indicated the growth in the production of palm oil over the years, also the import of palm oil shows that the consumer will go for the imported products, leaving the output supply by our farmers to suffer.

Keywords: ADF, ARDL, VECM, Palm oil.

1. INTRODUCTION

Oil palm is one of the most important economic oil crops in Nigeria. According to World Rain Forest Movement, oil palm is indigenous to the Nigeria Coastal plain through it has migrated inland as a stable crop. Cultivation of palm oil serves as a means of livelihood for many rural families and indeed the farming culture of millions of people in the country. (Adeyemo, 2015). The reference of oil palm as a crop of multiple value underscores its economic importance. Oil palm is made of essential components, namely: the fronds, the leaves, the trunk and the root which are used for several purposes ranging from palm oil, palm kernel, palm wine, broom, and palm kernel cake (Foundation for partnership initiatives in the Niger Delta, PIND). As of early 1900. Nigeria was producing oil palm sold in the world market and it was considered a dominant source of foreign exchange. Up until 1960s, Nigeria was the world largest producer of palm oil accounting for 43% of global palm oil production. (Chigozirim *et al*, 2015). Over reliance on traditional production methods, excessive tapping of palm trees for palm wine and the civil war from 1967 to 1970, are factors that contributed to Nigeria's inability to meet up with the global rise in demand of palm oil (Chigozirim and Chibuzor, 2015).

Oil palm is also an essential food item. About 90 percent of the palm oil produced ends in food products, while the remaining 10 percent is used for industrial production. As a result of its world's population increases and standards of living rise. Production of palm oil is more sustainable than other vegetables oils. It consumes considerably less energy in production, uses less land and generated more oil per hectare than other leading vegetables oil. Palm oil is used for preventing vitamin A deficiency and is rumored to be good for cancer sufferers, brain disease, aging and treating malaria, high blood pressure, high cholesterol and cyanide poisoning. It is used for weight loss and increasing the body's metabolism. As a food, palm oil is used for cooking and frying. Industrially, palm oil is used for manufacturing cosmetics, soaps, toothpaste, waxes, lubricants and ink.

According to Emeifele (2015), there have been many narratives over the years and in recent times on what led to this downward trend, with blames being apportioned by different parties along the palm oil value. This poses a very precarious situation for the manufacturing sector that depends largely on palm oil as a major source of raw material. Nigeria today produces only 1.7 percent of the world's consumption of palm oil which is insufficient to meet its domestic consumption which stands at 2.7 percent.

The output supply of palm oil in Nigeria has been affected by some factors which may include the import and export of palm oil, the producer price, climatic variables as well as area harvested. Agriculture has been the most important single activity in Nigeria economy with about 70 percent of the total working population engaged in it (Abolagba *et al*., 2010). Nigeria has also been ranked very high in the production and exportation of some major crops in the world in the 1940s and 1950s. it has been said that agricultural products tend to have the characteristics of a low price elasticity of demand while mineral export commodities are known to have high price elasticity of demand. Fluctuation in commodity price poses a real challenge to the economics of developed countries for instance United States and Japan and other African countries where Nigeria is no exception. Sardosty, (1999) and Hamilton, (1983) indicates that commodity price especially energy prices exert significant effect on a country's economy. This is true in the case of palm oil prices and crude oil prices but it should be considered importantly when comparing palm oil and crude oil for experts that crude oil is an exhaustible asset which makes it unreliable and unpredictable for sustenance of the development of the country's economy.

This research work will therefore answer the following question:

1. What are the trends in production output and producer prices of palm oil?

2. What is the effect of import and export on palm oil production in Nigeria?

2. LITERATURE REVIEW

Oil palm is a topical crop of the rainy tropical lowlands. The tree requires a deep soil, a relatively stable high temperature and continuous moisture throughout the year. Soil fertility is less important than physical soil properties. Dry periods of more than 2 – 3 months do not specifically damage vegetative growth, but after seriously the production and quality of the fruit bounds. Oil palm yield

is not only determined by vegetative growth and production, but also by way and pests and diseases can be controlled or eradicated.

Ahmed (2001) highlighted the importance of the economic tree crop in providing direct employment to other numerous people involved in processing and marketing. Omoti (2001) stated that Nigeria has enormous potential to increase here production of palm oil and palm kernel primarily through application of improved processing technique.

2.1 The Roots System of Oil palm

The root architecture is a fundamental aspect of plant productivity through it functional importance in the efficient acquisition of soil resources (water and nutrients uptake). The different n=morphological types of oil palm roots have been distinguished according to their development pattern and state of differentiation. As all the monocot, the root system of guineensis is fasciculate. The oil palm has an adventitious root system; with primary rots generally about 6 to 10mm in diameter, originating from the base of the trunk and bear secondary roots, of about 2 to mm in diameter. Tertiary roots, about 0.7 to 1.2mm in diameter, branch out from the secondary root, which in turn bear the quaternary roots. Quaternary root are undignified, about 0.1 to 0.3mm in diameter and 1 to mm long and they are often assumed to be the main absorbing roots. The total length of tertiary and quaternary roots in the soil is the most important root characteristics as they are the absorbing roots that affect fertilizer use efficiency. Most of the root biomass is found within 1m of the soil surface. Primary roots can grow up to 20m away from the base of the palm and some primary roots could penetrate below the water table at 90cm from the surface. The distribution of roots depends largely on the nature of the soil oil palm being a monocot needs a friable soil for root branching (Zureaidah 2010).

2.2 Origin and History of Oil Palm

It is generally agreed that the oil palm is originated from the equatorial tropical rain forest region of Africa, precisely along the gulf of guinea. It exists in the wild type and cultivated state. The American oil palm, *Elaeis oleifera* is a native to tropical Central America and South America. The male belts run through the southern latitudes of Cameroon, Cote d'lvoire, Ghana, Liberia, Nigeria, Sierra Leone, Togo and into the equatorial region of Angola and the Congo.

2.3 Ecological Benefits of the Oil Palm

Oil palm trees are a part of the natural ecosystem in especially Eastern Nigeria. In the region, most residential premises in the rural areas have pockets of palm trees as dominant economic trees in and around the home farmsteads. Both the palm trees in this category and those in plantations provide an array of ecosystem services. First, they often serve as windbreaks, while moderating the microclimate via the shade they provide to the prevailing under storey atmosphere and soil surface. Because of this foliar shading, oil palm trees support the growth of such shade-loving, lower-storey compatible intercrops as cocoyam (*Santhosoma sagittifolium*), otherwise, undergrowths are a part of oil palm plantations, and they have been reported to enhance soil biodiversity (Ashton-Butt *et al.,* 2018). Again, certain epiphytes and insects are known to be associated with oil palm (Adeleye *et al.*, 2016; Suzantiet *et al.*, 2017), as with most forest trees (Adubasimet *et al.,* 2018). The associations can be evident for the tall oil palm trees in natural/semi wild grove. As a fruit-bearing tree, oil palm also attract such arboreal rodents as squirrel. In al, oil palm trees in the long term support the growth of various plant species as well as attract variety of animals; therefore, the trees could be said to play crucial roles in promoting ecological balance. A related, major ecological benefit of oil palm groves or plantation is that they help to minimize soil erosion by water, a popular environment problem in southeastern Nigeria. Palm trees offer the much needed protection to the soil and the entire environment by at least two mechanisms; (i) ability of the closed tree canopy to intercept the usually high-intensity rainfall, thereby reducing its erosive power upon reaching the ground, and (ii) enhance structural-hydraulic properties of soils. This implies increased infiltration and soil water retention, such that plantation trees do serve as a biological measure of water conservation (Obalume *et al*., 2011). Regarding improvements in soil structural and hydraulic properties, oil palm plantation has severally been reported to be superior to arable cropping in southeastern Nigeria.(Ogan, 2017; Uzoma and Onwuka, 2018).

2.4 Socio-Economic Attributes of the Oil Palm

As a multipurpose tree, oil palm has a high socioeconomic value as virtually every part of the tree can be put into a gainful use. In view of the different uses of parts of the tree, the oil palm industry offers employment to many citizens and foreigners thus helping to reduce unemployment. By serving as a source of revenue for many families in rural areas of Nigeria, oil palm improves the economy of the country (Onoh and Peter-Onoh, 2012). Oil palm does not only create

employment and revenues for many rural families in Nigeria, but also improves the general livelihood of the people. For instance, the trunk is useful for building traditional houses and farm settlements. Palm trunk is also used as local culverts and as wedge against soil erosion. Palm fronds are used in yam staking and as a cheap material to construct will-aerated yam barns, erect make-shift canopies during ceremonies, and make thatched fences round residential premises. Also, palm fronds are fed as fodder to sheep and goats. The veins of the tree are used in making brooms and its fiber is woven into baskets, fish traps and climbing ropes, Notably, oil palms are taped to get palm wine, a highly-valued natural beverage. Palm wine has economic value as its tapping and marketing is a source of income to many rural households (Onuegbu *et al*., 2015.

(Aghalino, 2016), it can be processed further into palm kernel oil and palm kernel cake. The oil palm is thus considered a prime plant for the production of vegetable oil, producing two types of oil viz palm oil from the mesocarp and palm kernel oil from the kernel, unlike most other oil-producing plants. These two types of oil are in high demand all over the world, with palm oil being the major product. The palm oil goes with many socio-economic attributes, serving both food and industrial purposes. Interestingly, virtually none of the materials released during the processing of palm fruits and which are perceived not to hve any immediate socio-economic value of the time of pickingthe desired goods could be considered 'wastes'. These supposedly waste materials can be put to beneficial uses. The leftover after detaching the fruits from the bunch, popularly referred to as empty fruit bunch, has traditionally been used in soil and water management for especially the purpose of arable crop production. The empty fruit bunch serves as mulch material and too can be composted and used as organic fertilizer. It has also found use as a feedstock for high-quality biochar (Idris *et al*., 201; Bakar *et al*; 2015; Rozahan *et al*., 2015). The empty bunch, when burnt, it can be used to make local soap. Also, palm oil-mill effluents or wastewaters released during palm fruit processing are potential rich organic fertilizers for enhancing crop production in low-fertility tropical soils (Nwoko and Ogunyemi, 2010; Eze *et al*., 2013; Mohd Nizar *et al*., 2018) ; however, such vegetable oil-mill effluent must be treated or fermented properly before use to avoid inhibiting crop growth (Ubani *et a*l, 2017; Okorie *et a*l., 2017).

3. METHODOLOGY

3.1 Study Area

Nigeria is located on the Southern coast of West Africa between latitude 3.5^{o}N and 14.5^{o}N Longitude 3^{o}E and 14^{o}E with Benin border to the West and Chad to the North and Cameroon to the East with landed areas of over 923,773 square kilometer and is extensive suitable for cultivation and human practices, thus the country is blessed with favorable climatic conditions which is good for almost all the foods crops especially oil palm.

3.2 Data Source and Collection Methods

The data used is secondary data which include time series micro level data. The data was sourced from various issues of Central Bank of Nigeria (CBN) statistical bulletin and the statistical database of the Food and Agricultural Organization of the United Nations.

The features of the data include:

1. Palm oil price.
2. Palm oil production and export
3. Crude oil price

3.3 Analytical Technique

Unit Root Test using the ADF test technique to test if the time series data were stationary, Autoregressive Distributed Lag (ARDL) co-integration and error correction tests were also used.

3.3.1 Co-integration Test and Error Correction Estimates

The Autoregressive Distributed Lag (ARDL) model developed by Pesaran *et al*., (2001) is deployed to esitimate our model because of three reasons. First, Pesaran *et al*., advocated the use of the ARDL model for the estimation of level relationships because the model suggests that once the order of the ARDL has been recognized, the relationship can be estimated by OLS Pesaran *et al*., (2001). Second, the bounds test allows a mixture of I (1) and I(0) variables as regressor, that is, the order of integration of appropriate variables may not necessarily be the same. Therefore, the ARDL technique has the advantage of not requiring a specific identification of the order of the

underlying data. Third, this technique is suitable for small or finite sample size Pesaran *et al*., (2001).

Following Pesaran *et al*., (2001) we assemble the vector auto regression (VAR) of order *p*. denoted VAR(*p*), for the following growth function:

$$Z_t = \mu + \sum_{t=1}^{p} \beta_t z_t = 1 + \varepsilon_t \qquad (1)$$

(I)

where z_t is the vector of both *x t* and *y t*, where *y t* is the dependent variable defined as palm oil output, *t x* is the vector matrix which represents a set of explanatory variables. According to Pesaran *et al*., the dependent variable *t y* must be (I) variable, but the independent *t x* can be either I(0) or I(1).

The vector error correction model (VECM) is specified as follows:

$$\Delta z_t = \mu + \alpha t + \lambda z_{t-1} + \sum_{t=1}^{p-1} \Delta_t y_{t-1} + \sum_{t=1}^{p-1} \Delta_t \gamma_t \Delta_{t-1} + \varepsilon_t \qquad (2)$$

$$\lambda = \begin{bmatrix} \lambda_{tY} \lambda_{tY} \\ \lambda_{tY} \lambda_{tY} \end{bmatrix}$$

The diagonal elements of the matrix are unrestricted, so the selected series can be either I(0) or I(1). If $\lambda_{YY} = 0$, then *Y* us I(1). In contrast, if $\lambda_{YY} < 0$, then *Y* is *I*(0).

The VECM procedures described above are imperative in the testing of at most one co-integrating vector between dependent variable *t y* and a set of regressors *t x* (Pesaran *et al*., (2001) and Atif *et al*., (2010).

To drive model, we followed the postulations made by Pesaran *et al*., (2001) in Case III, that is, unrestricted intercepts and no trends

After imposing the restrictions ($\lambda_{YY} = 0$, $\mu_{YY} \neq 0$): the error correction model of the ARDL model is specified as follows

$$\left[\begin{array}{c}\Delta(output)_{t} = \beta_0 + \sum_{t=1}^{p}\Delta(output)_{t-1} + \sum_{t=0}^{q}\beta_2\Delta(export)_{t-1} \\ + \sum_{i=1}^{p}\beta_3\Delta(input)_{t-1} + \sum_{t=1}^{q}\Delta(price)_{t-1} + \sum_{i=1}^{r}\beta_5\Delta(rainfall)_{t-1} \\ + \sum_{i=1}^{p}\beta_6\Delta(are\ harested)_{t-1} + \sum_{t=1}^{q}\Delta(yield)_{t-1} + \ \mathrm{ECM}_{t-1}\end{array}\right]$$

Where Δ is the first-difference operator and ECM t –is an Error correction term.

Output – producer price (naira)

Import – import quantity (in tonnes)

Export – export quantity (in tonnes)

Rainfall – rainfall (mean rainfall value)

Yield – yield of palm oil (in tonnes)

T – Time

ECM – error correction term

4.1 RESULT ANALYSIS AND DISCUSSION

4.1.1 Analysis of Growth in Palm oil in Nigeria

Table 1 explains that time was a positive determinant of the differences/volatilities in the growth in palm oil production. This significant coefficient implies that palm oil production grows over time. Which means the growth is time determined. The model had a good fit of R^2 value of 0.92 and a significant F value of 372.46. Since the coefficient are recorded to be positive, palm oil production recorded growth during the period at which it was studied.

Table 1: Description of analysis of growth in Palm Oil in Nigeria

	b0	**b1**	**R^2**	**F-statistic**
Palm oil output	5.23£ + 06 (25.2031)*	86422.6 (15.4124)*	0.92	372.46

Source: Computation from STATA 12 analysis. 2021

Note: Food and Agricultural Organization (FAO) data base values are in parenthesis are t-values

* means the data are statistically significant at 1% level

4.1.2 Unit Roof Test of the Variables

Table 2 describes the unit root test of the variables with constant and trend. The results shows that all the variables were integrated at difference except for palm oil yield and since all the variables are not integrated in the same order; there is a need for a co-integration test. This implies that some linear combination of the series must be co-integrated, such that even though the individual series may be integrated in the order 1(I), the series may drift apart in the short-run, and then follow a common trend which permits stable long-run relationship between them.

Table 2: Unit root test of the variables

Variables	Level Tax	P-value	Difference Tax	P-value	Order of integration
Area harvested	–3.311	0.5634	– 8.441	1.602£.06	1(I)
Yield	–3.925	0.567	–3.204	0.31	1(0)
Output	1.603	0.9733	–5.160	0.008227	1(I)
Producer price (Leu/tnne)	–3.988	0.0805	–5.812	5.61£05	1(I)
Exported value	0.701	0.9987	–4.630	0.008137	1(I)
Exported value	–7.801	0.0020	–4.507	0.00856	1(I)
Rainfall	–4.203	0.310	–3.824	0.0962	1(I)

Source: Computation from STATA 12 analysis. 2021 from the data obtained from UNDP and FAOSTAT.

Note: I(0) and I(1) are integrated at level and first difference.

4.1.3 Autoregressive Distributed LAG (ARDL) Model Co-integration Test and Error Correction Estimates

Table 3 displays the calculated F-statistics (F-statistic = 28.6), showing that the null of no co-integration can be rejected at 1.0 percent level. This implies that there exists a long run relationship or co-integration relationship, the next step is to estimate the long run coefficient by

estimating an ARDL. The result shows that the long run overall model is well fitted as the independent variable explained over 97%(R^2) movements in the dependent variable.

Table 3: Estimated Long-run Coefficient ARDL

Variables	Coefficient	Standard Error	T-statistics
Palm oil output	3314801	3482238	9.52
Export (– I)	598234	265781	2.25
Import (– I)	–384874	494670	7.78
Price (– I)	407647	807890	5.05
Rainfall (– I)	801756	798477	0.80
Area harvested (– I)	–7457801	268251	– 2.78
Yield	3011678	2941671	1.02
Constant	–1.48£08	2146024	– 6.4

Source: Computation from STATA 12 analysis. 2021. From the data obtained from UNDP and FAOSTAT.

R-squared	0.976438
Adjusted R-squared	0.966479
S.E of regression	106824.2
Sum square residual	1.19£+11
Log likelihood	–246.885
F-statistic	28.60437
Prob (F-statistic)	0.000009
Mean dependent variable	9084321
S.D dependent variable	4845670
Akaike info criterion	27.40669
Schwarz criterion	26.84231
Hanna-Quinn oriterium	26.58245
Durbin – Watson Statistic	2.38062

Table of Error Correction Estimates of the ARDL Model

The long-run coefficients show that export of palm oil exhibits a positive significant relationship with output supply of palm oil so does the lag of output supply of palm oil itself. Imports of palm oil and area harvested are inversely related to output supply of palm oil. The coefficient of importation of palm oil was statically significant at 5% and negatively influencing the output supply of palm oil in Nigeria. Most of the manufacturers that use palm oil as a major raw material will go for the imported palm oil leaving the domestic output to suffer. But the export of palm oil had a positive significant impact on the output supply of palm oil in Nigeria. The increase in the level of exports motivates the farmer the produce more output.

Area harvested has negative impact on the output supply of palm oil. As the population grows, the area harvested shrinks due to the effect of urbanization and this will reduce output supply of palm oil.

According to Granger representation theorem, when variables are co-integrated, there must also be an error correction model (ECN) that describes the short run dynamics or adjustment of the co-integrated variable towards their equilibrium values. The result of the ECM is presented. The error term is negative and highly significant. Export and yield of palm oil haed a short run negative impact on the output supply of palm oil.

Table 4: Error Correction Estimate of the ARDL model

Variables	Coefficient	Standard Error	T-statistics
Constant	–98613.9	156799	6.04
D supply	5.35840	1.36880	3.91
D [supply(–1)]	7.95630	1.56831	5.07
D [supply(–2)]	7.01088	2.41036	2.91
D [supply(–3)]	–0,74368	0.513791	–1.45
D(Harvested area)	–17.64365	3.53489	– 4.99
D(Harvested area –1)	–9.26789	2.24589	– 4.13
D(Harvested area –2)	12.9635	3.98561	3.25
D(Harvested area –3)	14.49461	3.49361	4.19

D(import)	– 0.03837	0.03098	–1.24
D [import(–1)]	–1.0090	0.69394	–1.45
D [import(–2)]	0.43867	0.47120	0.93
D [import(–3)]	– 0.02345	0.63982	–0.04
D(Export)	–30.5681	11.9985	–2.55
D [Export(–1)]	–14.9538	10.9658	–1.36
D [Export(–2)]	–3.98407	9.38541	–0.42
D [Export(–3)]	–5.80117	12.2580	–0.47
D(price)	6.75643	2.06801	3.27
D [price (–1)]	3.25879	1.16834	2.81
D [price (–2)]	3.94569	1.72596	2.29
D [price (–3)]	8.35896	5.96897	1.40
D(Rainfall)	2064.32	3368.53	0.60
D [Rainfall (–1)]	2448.69	2698.92	0.91
D [Rainfall(–2)]	–6745.71	6891.54	–0.98
D [Rainfall (–3)]	–8017.91	6946.60	–1.15
D(Yield)	–238.487	48.2369	–.4.94
D [Yield (–1)]	–846.103	396.368	–2.13
D [Yield (–2)]	1910.48	56.9483	3.35
D [Yield (–3)]	149.846	116.3578	1.29
ECM	–12.5643	2.35701	–5.33

Source: Computation from STATA 12 analysis.

R-squared	0.976438
Adjusted R-squared	0.966478
S.E of regression	106824.2
Sum square residual	1.19£+11
Log likelihood	–246.885
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Akaike info criterion	27.40669
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5. CONCLUSION

The study discover that all the variables have constant mean except for palm oil yield using the Autoregressive Distributed Lag (ARDL) model co-integration test. The co-integration test revealed that there exists a long run relationship between production of oil palm and its determinants. The independent variables with significant long run coefficients were imports, exports and area harvested. The error correction term shows high level of adjustment towards long run equilibrium. In the long run the impact of export was positive while in the short run it was negative. By implication in the short run exports of palm oil affects the output supply inversely while in the long run it results to the increase in the output supply palm oil. The impulse response shows the response of the palm oil output supply to its determinants, which was in line with the findings of the short run and long run coefficients.

In this study it was found that the trend in the output supply of palm oil shows significant growth rate based on coefficient of time trend which was significant at 1% and positive. It can be concluded that the trend indicated the growth in the production of palm oil over the years, also the import of palm oil shows that the consumer will go for the imported products, leaving the output

supply by our farmers to suffer. The export of palm oil indicated that, exporting of palm oil encourages the farmers to increase their production in the long run.

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