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An empirical evaluation of the impact of Dutch disease on the Nigerian agricultural sector (1981-2016)

Julius Joses Orvoty and Adamu Jibrilla

Abstract
This study investigates the impact of Dutch disease on agriculture sector in Nigeria for the period of 35 years. It examines the causal as well as long run relationship between Dutch disease and agriculture sector in Nigeria over the study period. It is empirically evident that increase in only a single growing sector (oil sector) adversely affects the growth and development of other sectors in an economy. The study uses econometric regression tool to estimate the multivariate model, correlation analysis, OLS, Unit root test, Johansen co-integration test, vector error correction mechanism as well as granger causality have been used in the analysis of data. The result reveals that Crude oil prices (COP) negatively affects the Agricultural output (AGO). All the variables used except inflation rate (INF) are found to have the same order of integration that is, I(1) and also a long-run co-integration relationship among Agricultural output (AGO), Crude oil prices (COP), Real Gross Domestic Product (RGDP), Inflation rate (INF) and Exchange rate (EXCR) was found to exist. The study recommends that proceeds from oil should be used optimally to develop the agricultural sector in order to reduce dependency on oil sector and also to boost the agricultural sector.

Keywords: Dutch disease, agriculture, crude oil, Nigeria

1. Introduction
Agriculture is a very significant tool for economic development. It is the mainstay of most economies and also the backbone to the socio-economic development of a nation as well as a fundamental element and factor in national development. The agricultural sector of an economy is said to be strong and efficient if and only if that country is able to feed its growing population, generates employment, earn foreign exchange and provide raw materials for the industrial sector. Since independence in 1960, the Nigeria's external sector has been the same and it is characterized by an overriding single growing sector. In the two decades after the independence, the external sector was dominated by agricultural export. It accounted for about 50% of the GDP, employed more than 75% of the labour force and produced over 70% of the total food consumption (Reynolds, 1966) [23]. The Agricultural sector is a strong hold in an economy, for without it a country's diversification will be highly impeded which will eventually lead to a nation's dependent on foreign countries to feed its population, the potential ways by which this sector contributes to economic growth has resulted to the debates among a good number of economists (Oji-Okoro, 2011, Gollin, Parente and Rogerson 2002) [11, 7].
The sole dependent of the Nigerian economy on oil sector due to the fact that it is among the ten largest producers of oil as well as the largest producer in Africa. The sector accounted for about 76% of the government revenue and 95% of the export earnings, thus, in spite of these huge amounts of revenue generated from the oil sector, the economy still remains below the poverty level (Opeyemi, 2012). This paper is of the argument that oil sector has resulted to a great retardation in Nigeria's agricultural development by not seeking and preparing for diversification which makes it a curse rather than been a blessing. This is due to the fact that since the discovery of oil in Nigeria, agricultural sector has virtually been neglected leading to massive importation of food items which were previously produced domestically. For instance, Manyong, Ikpi, Olayemi, Yusuf, Omonona, Okaruwa & Idachaba (2005) stated that in spite of Nigeria's rich agricultural resource endowments, there has been an acute decline in the agriculture's contributions to the nation's wealth. In 1960s, agriculture accounted for 65-70% of the total exports; it fell to about 40% in the 1970s and crashed to less than 2% in

the late 1990s. This decline in the agricultural sector was largely due to the peak in oil boom in early 1970s (FGN, 1983) [6]. Bature, (2013) [3] stated that the consequences of depending on a booming sector began to manifest intensively when Nigeria began to produce less than a million barrels of petrol per day and sold it for about $30 per barrel as against an earlier 2.5million barrels per day in 1979 and at tagged price of $40 per barrel and a number of countries have suffered from such situation due to overdependence on a single growing sector. Therefore, the evidence and or an indication of what is called "Dutch disease" in Nigeria is due to the augments of crude oil exploration and exploitation as well as the geometric dwindles of the agricultural sector of the economy (Oyesanmi, 2011; Ogbonna, Uwajumogu, Chijioke and Nwokoye, 2013; Duruji and Dibia, 2017) [22, 17, 5]. Moreover, at the peak of the oil boom, NRGI, (2015) [16] observed that other sectors of the economy, to be precise the export-based manufacturing sectors are hurt as a result of the large increase in natural resource revenue. This harm to other sectors is done by causing inflation or exchange rate appreciation and shifting labour and capital from the non-resource sector to the resource sector of the economy (Ross, 1999). In fact, Nigeria can no longer cultivate food for its fast-growing population neither could the agro-based industries operates at full capacity to serve the nation domestically as well as exporting to the international market (Aliyu, 2011) [2]. In addition to this, it is very puzzling that in spite of Nigeria's huge agricultural potentials, the importation of much quantities and varieties of foods to feed its geometric population is on the high increase (Onuka, 2017) [20].

The theory originated in 1960s from the Netherlands now Holland and due to the exploitations and explorations of newly found gas reserves positioned in the North Sea, revenues dominated in hard currencies was earned and the domestic Dutch guilder began to appreciate in value sharply, this in turns leads to hurting the non-oil sector such as agricultural sector and or the manufacturing sector and its exports also dwindled in the world markets, this effect in short has an overall negative effects on the whole economy, leaving oil to dominate the economy as a result of the non-oil sector (agriculture and manufacturing sector) been crowded out. The enormous influx of cash from oil tends to foster wasteful, overzealous, extravagant spending and in fact the high oil revenue raises exchange rate and promotes adverse balance of payment as the cost of imports rises (Otaha, 2012) [21].

According to Lewis (1984) [14] the increase in natural gas price associated with balance of payment surpluses resulted in an increasing guilder during the 1970s. The appreciation in turn works against the manufacturing sector. The "core model" of Dutch disease was outlined by Corden and Neary (1982) [4]. This comprised of the spending effect (SE) and the resource movement effect (RME). The model was used to describe the mechanisms through which what would initially seem to be an economic boon for a nation inverts and produces a paradoxically adverse consequence.

Nigeria is an economy whose initial exports were tradable agricultural goods, but due to the advent of oil it shifted to export of booming sector and consequently this leads to a real exchange rate appreciation and the extinction of the initial agricultural exporting sector. According to Adebisi (2012) [1], since that oil boom, the appreciation in real exchange rate caused Nigeria to become an importer of food, where previously it was not so. The total spending on the non-tradable (service) sector rises if its supply is not perfectly elastic and then there is appreciation in the price of tradable if the tradable remains the same as a result of this. In this situation, it can lead to an acute de-industrialization or in underdevelopment of the agricultural sector. Generally, this means a process of reallocation of resources from the tradable sectors to the non-tradable sectors in the presence of real exchange rate appreciation. Nigeria's experience is as a result of the combination of economic and non-economic factors. The economic factors relate to the underlying fundamentals, to inappropriate economic policies and planning, the non-economic factors have more to do with misappropriation and mismanagement of public funds (Adebisi, 2012) [1].

Empirical evidence (Olusi and Olagunju, 2005; Aliyu, 2011; Adebisi, 2012; Chukwuka *et al*, 2013; Ijirshar, 2015; Bature, 2013) [19, 2, 1, 3, 12] recognized the impact of Dutch disease on agricultural sector in Nigeria. However, their studies were limited because of the methodology as well the time frame. The impact of Dutch disease on agricultural sector in Nigeria may engender requires ample information concerning both its existence and extent on the Nigeria economy. Also, the potential for exposure to the causes of the disease and as well as its potential impacts such as more harm to other sectors caused by inflation or exchange rate appreciation and shifting labour and capital from the non-resource sector to the resource sector of the economy. In this research work, the impact of Dutch disease on agricultural sector in Nigeria will not only be address but its rate and extent at which it affects the economy will be look into.

In order to experience an economic growth and development in an economy, diversification which is the exploitation and development of various sectors if not all is a pre-requisite. However, this has not been the case in Nigeria due to the neglect of agricultural sector resulting from cheap oil revenue. Hence, this paper is of immense importance to the nation and it intends to determine the impact of Dutch disease on agricultural sector in Nigeria from 1981 to 2018 as its main objective, while the specific objectives are to: investigate the directions of causal relationship between Dutch disease and agriculture in Nigeria from 1981 to 2018 and explore the long run relationship between Dutch disease and agriculture in Nigeria from 1981 to 2018.

The organization of the paper is as follows; an introduction in section 1; brief literature review in section 2; model specification and techniques of data analysis (econometric methodology) are outlined in section 3; the empirical findings are presented in section 4 and the conclusion and policy implications are presented in section 5.

2. Literature Review

The term Dutch Disease was originally referred to the adverse effects of the large North Sea natural gas discoveries of the Netherlands on the Dutch manufacturing sector and economic growth (Shakeri and Gray, 2010) [10]. This is an economic term which refers to as the general effects of a booming export commodity on an economy. The booming sector drives up the cost of labour and other non-tradable inputs, which makes other tradable sectors, particularly the manufacturing sector, less competitive. Because the manufacturing sector tends to be more

innovative than others, this can lead to permanently lower rates of growth in the economy.

The Dutch disease is the apparent causal relationship between the increase in the economic development of a specific sector and a decline in other sectors (Manufacturing or Agricultural sector). The putative mechanism is that as revenues and or inflows of foreign aid increase in the booming sector, the given nation's currency becomes stronger (appreciates) compared to currencies of other nations. This result in the nation's other exports becoming more expensive for other countries to buy and imports becoming cheaper, making those sectors less competitive in the world market. It is certainly not healthy for a country to be dependent on only one sector. Thus, if a country like Nigeria develops the agricultural sector along with other sectors like the manufacturing, oil and mining, this will help in diversifying the economy (Lambo, 1987) [13]. According to Oyesanmi (2011) [22] this negative effects of natural resources booms on countries retards their economic transformation.

The classical economic model of Dutch disease was developed by W. Max Corden and J. Peter Neary in the year 1982. This model follows the channels in which the natural resource wealth can or do affects the economy. It also focuses on the development effects of the phenomenon Dutch disease, particularly the negative effects in relation to the productivity dynamics and volatility.

In the model, the economy is model into three sectors: the two tradable sectors that is the booming sector and the lagging sector and the other sector is the non-tradable sector. The booming sector in this model is the extraction of natural resources (oil, natural gas, gold, diamonds etc.). The lagging sector is usually the agricultural and or manufacturing sector in an economy. And the non-tradable on the other side is the services and construction sectors of an economy. Both prices of the booming and lagging sector are set internationally at the world market and those prices of the non-tradable sectors of services and constructions are domestically set within an economy. Generally, there are two types of effects leading to Dutch disease and real exchange appreciation (two ways in which resource boom affects the economy);

a. **The spending effect:** This is the result of the increased domestic income from the growing natural resource sector (the extra revenue brought in by the resource boom) results to a higher aggregate demand and the spending by both the public and private sectors. The increased demand for non-tradable sector (services) results to higher prices and output in the sector and this in turns rises wages in the economy and squeeze the profits of the lagging sector (the agricultural and or manufacturing sector). However, prices in the traded booming sector are set internationally, so they cannot change. This amounts to an increase in the real exchange rate. And as a result of these, the demand for labour in the non-tradable sector (services) increased, at the expense of the lagging sector. This shift from the lagging sector to the non-tradable sector is called indirect-deindustrialization or indirect-agriculturalization.
b. **The resource movement effect:** the effect is due to the consequences of the perfect mobility of capital and labour from the lagging sector (manufacturing sector, agricultural sector in the case of Nigeria) to the booming and non-tradable sectors. This shift in labor from the lagging sector to the booming sector is called *direct-deindustrialization* or in the case of Nigeria *direct-agriculturalization*. The resource movement effect is as a result of the increased oil price which leads to a rise wages and profits. This leads to an increase in aggregate demand in the economy, to an extent that the part of this demand will move towards the services sector and this leads to the increase in the prices of non-tradable goods (World Bank, 2010) [26].

The impact of Dutch disease on the agricultural sector can be empirically analyzed. In this respect, several empirical studies emphasized on the impact, evidenced, and extent of Dutch disease on other sectors of an economy. Sachs and Warner (1997) [24] investigate the relationship between natural resource abundance and economic growth. Using time series data from 1970-1990 and variables for 18 countries, the growth regression analysis result reveals that countries that have high ratio of natural resource export to Gross Domestic Products (GDP) grew slowly during the period. The study also discovered that even after incorporating other control variables, a negative relationship between natural resources export and economic growth still exists.

Gylfason *et al*. (1999) [10] empirically diagnosed the symptoms of the Dutch disease with evidence from 85 countries. Their paper provides a series data from 1965 to 1998. In their study, a two-sector stochastic endogenous growth model was applied to. The results of their investigation suggest that abundant natural resources may on average caused crowding out, thus stagnating economic growth. Additionally, their results also suggest that abundant natural resources may hurt saving and investment indirectly by slowing down the development of the financial system.

Olusi and Olagunju (2005) [19] examined the presence of the Dutch Disease using Nigeria as a case study; in their study a quarterly data from 1980 to 2003 was used. A vector autoregressive (VAR) modeling was used as their method of estimation and the result reveals that the economy suffers from the Dutch disease. Olusi *et al*. (2005) [19] has failed to use descriptive analysis in order to have more information about all the variables.

Aliyu (2011) [2] had an empirical work where the graphical descriptive statistics and the one-way analysis of variance technique was used, the investigation sought to know whether the neglect of agricultural sector was due to a result of the discovery and exploitation of oil in Nigeria during the period of oil boom (1973-1983). The research work found a significant increase in the quantity of capital expenditure allocated to agricultural sector during the period of oil boom and thus, more capital expenditure was allocated to agricultural sector than was allocated to either of health, education and defense sector in Nigeria during that period. After His study, He concludes by rejecting the hypothesis that the neglect of agricultural sector was due to oil boom.

Adebisi, (2012) [1] examined the Vector autoregressive analysis of oil and exchange rate in Nigeria; a case of Dutch disease. He used annual time series data from 1960 to 2010. His study covers both fixed and post fixed exchange rate system in Nigeria. A Vector autoregressive (VAR) modeling, Impulse response functions (IRF) and Variance decomposition analyses was used. In his study Dutch disease was diagnosed and conclusion was made that the

contraction of the agricultural sector in Nigeria was as a result of the sudden windfall from oil.

Chukwuka *et al*, (2013), (2013) examined the oil exploitation and agricultural commodity export in Nigeria, taking an empirical evaluation of the extent and impact of Dutch disease from 1970 to 2011 that is, an annual time series data was used. Their study evaluates how the discovery and exportation of crude oil has impacted on the production and exportation of agricultural output. The study was analysed using co-integration and vector error correction model in other to explore the long-run relationship between agricultural commodity export and oil export. The results of this study show that in the long-run, Dutch disease is present in Nigeria and also a 1% increase in oil export will depress agricultural commodity export by 16%, that is the more Nigeria produces and export oil, the lower the output and less competitive the traditional tradable sector becomes. Chukwuka *et al*, (2013) fails to carry out the correlation analysis in order to measure the relationship among the variables, which is positive or negative relationship that exists among the variables.

Hasanov (2013) [11] analyzed whether there are any symptoms of Dutch Disease in Azerbaijani economy. A time series data from 2001 to 2007 was used by employing testable hypotheses while carefully checks alternative explanations of observed consequences. His result shows that there has not been absolute de-industrialization, but observed relative deindustrialization in the non-oil tradable sector and substantial expansion in the non-tradable sector. Government expenditures have created the "spending effect" and this effect has been more significant than the "resource movement effect". There have been evidences of a rapid increase in average wage and high price in the non-tradable sector and therefore an appreciation of the real exchange rate.

Ijirshar (2015) [12] had an empirical analysis of agricultural exports and economic growth in Nigeria. An annual time series data from 1970 to 2012 was employed in the analysis. For His empirical analysis, the econometrics techniques used were: Augmented Dickey-fuller (ADF) unit root test, Johansen Co-integration test and Error Correction Model (ECM). The results of the analysis show that; the results of the unit root test suggested that index of trade openness and inflation rate was stationary at a level while real gross domestic products, real exchange rate and real agricultural exports were integrated at order one. The co-integration test showed that long-run equilibrium relationship exists among the variables. Also, the result of the Error Correction Model shows that agricultural export has contributed positively to the Nigerian economy. From His findings, He concluded that the agricultural production should be more desired than other sectors that are exhaustive in nature most especially the oil sector evidenced to the recent fall in price of crude oil which has rendered Nigeria in economic shambles.

3. Methodology

In this section, we discussed on the type and sources of data used in the research work, model specification and method used in analysing the data.

The data used in the course of this research are essentially annual time series data, collected with respect to; Agricultural output (AGO), Crude Oil Prices proxy for Oil rents (COP), Inflation rate (INF), Real Gross Domestic Product (RGDP) and Exchange Rate (EXCR). The data are sourced from Central Bank of Nigeria's Statistical Bulletin, Journals, National Bureau of Statistics and World Development Indicators.

Econometric tool is employed in the specification of relevant model estimated in this study showing the influence of the independent variables on the dependent variable and also testing the relevant hypothesis stated in the research.

The Functional Relationship is as follows:

$$AGO = f(COP, RGDP, INF, EXCR) \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

Linear Relationship is as follows:

$$AGO = \beta_0 + \beta_1 COP + \beta_2 RGDP + \beta_3 INF + \beta_4 EXCR \quad \ldots (2)$$

Econometric Relationship is as follows:

$$[\![AGO]\!]_t = [\![\beta_0 + \beta]\!]_1 [\![COP]\!]_t + [\![\beta_2 RGDP]\!]_t + \beta_3 [\![INF]\!]_t + \beta_4 [\![EXCR]\!]_t + \mu_t \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where

AGO_t = Agricultural output at period t

COP_t = Crude Oil Prices Proxied by Oil Rents at period t

$RGDP_t$ = Real Gross Domestic Product which is proxied Economic Growth at period t

INF_t = Inflation rate at period t

$EXCR_t$ = Real Effective Exchange Rate at period t

μ_t = Stochastic Error Term

t = Time period

β_0 = the intercept of the model

$\beta_1, \beta_2, \beta_3$ and β_4 = Regression Coefficients of the independent variables.

A priori Expectations

$\beta_1 < 0$, $\beta_2 > 0$ $\beta_3 < 0$ and $\beta_4 < 0$

3.1 Descriptive statistics

Correlation analysis is being conducted to determine the correlation among the variables of interest. The mean, median, maximum and minimum, standard deviation, skewness and kurtosis of the variables are also being examined.

3.2 Unit Root Test

The Unit Root Test is used to test whether the data employed in this study are stationary or non-stationary in order to avoid spurious regression. This is because most economic variables exhibit upward trends and therefor non-stationary. The null hypothesis is that there is a unit root and when it is rejected, it is said to be stationary. According to Gujarati (2013) [9], a non-stationary time series will have a time-varying mean or a time-varying variance or in fact both (that is an unstable moments). Therefore, stationarity test is necessary when dealing with time series data, but before it needs to be transformed to a stationary state because most time series observations are non-stationary. It is done in order to bring a stand still in its moments, the study of a non-stationary time series behavior is only for the time period under consideration. It is not possible to generalize it to other time periods. Thus, for the purpose of forecasting, stationary time series is of practical value and most

economics time series are expected to be I(1). Although there have been many tests suggested for unit roots, this study employed the Augmented Dickey-Fuller (ADF) test because it is reported to have a good size. The general form of ADF test is given as:

$$\Delta Y_t = \beta_1 + \beta_2 + \delta Y_{t-1} + ai\sum_{i=1}^{m} \Delta Y_{t-i} + \varepsilon_t$$

Where

Y_t: is the variable to be investigated.

Δ: is the differential factor

ε_t: is pure white noise error term

The individual form of the ADF test based on intercept and trend based on this study is as follows:

$$\Delta AGO_t = \beta_1 + \beta_2 t + \beta_3 AGO_{t-1} + \sum \beta_4 \Delta AGO_{t-1} + \mu_t \ldots\ldots (4)$$
$$\Delta COP_t = \beta_5 + \beta_6 t + \beta_7 COP_{t-1} + \sum \beta_8 \Delta COP_{t-1} + \mu_t \ldots\ldots (5)$$
$$\Delta RGDP_t = \beta_{13} + \beta_{14} t + \beta_{15} INF_{t-1} + \sum \beta_{16} \Delta INF_{t-1} + \mu_t \ldots (6)$$
$$\Delta EXCR_t = \beta_{17} + \beta_{18} t + \beta_{19} EXCR_{t-1} + \sum \beta_{20} \Delta EXCR_{t-1} + \mu_t \ldots (7)$$
$$\Delta EXCR_t = \beta_{17} + \beta_{18} t + \beta_{19} EXCR_{t-1} + \sum \beta_{20} \Delta EXCR_{t-1} + \mu_t \ldots (8)$$

Where

AGO_t = Current value of Agricultural Output.

AGO_{t-1} = last value of Agricultural Output.

COP_t = Current value of Crude Oil Prices.

COP_{t-1} = last value of Crude Oil Prices.

$RGDP_t$ = Current value of Real Gross Domestic Product.

$RGDP_{t-1}$ = last value of Real Gross Domestic Product.

INF_t = Current value of Inflation rate.

INF_{t-1} = last value of Inflation rate.

$EXCR_t$ = Current value of Exchange Rate.

$EXCR_{t-1}$ = last value of Exchange Rate.

$\beta_1, \beta_5, \beta_9, \beta_{13}$ and β_{17} = Constants (intercept)

$\beta_2, \beta_6, \beta_{10}, \beta_{14}$ and β_{18} = Coefficients of the trend

$\beta_3, \beta_7, \beta_{11}, \beta_{15}$ and β_{19} = Coefficients of the past value of the variables

μ_t = Pure white noise error term

3.3 Co-integration Test

Cointegration test is being conducted using Johansen co-integration approach in order to find out if there exists a long run relationship between the non-stationary variables in the model of this research or not. According to Gujarati (2013) [9], in order to conduct the co-integration test, it is necessary for the variables under investigation to be of the same order of integration. The condition underlying the Johansen cointegration test is that the variables under consideration must be integrated of order one, i.e., they must be I(1) variables. Therefore, the absence of co-integration implies that the variables do not have a long-run relationship.

$$\mu_t = \beta_0 - \beta_1 COP_t - \beta_2 RGDP_t - \beta_3 INF_t - \beta_4 EXCR_t - \beta_5 AGO_t \ldots\ldots\ldots (9)$$

COP_t = Current value of Crude Oil Prices.

$RGDP_t$ = Current value of Real Gross Domestic Product.

INF_t = Current value of Inflation

$EXCR_t$ = Current value of Exchange Rate

AGO_t = Current value of Agricultural output

μ_t = Stochastic Error Term

β_0 = Constant

$\beta_1, \beta_2, \beta_3$ and β_4, = Co-integrating Coefficients

3.4 Granger Causality Test

Granger causality is conducted to determine the causal relationship among the variables under study. It is a statistical concept of causality that is based on prediction. According to Granger (1969), if a signal X_1 "Granger-causes" (or "G-causes") a signal X_2, then past values of X_1 should contain information that helps predict X_2 above and beyond the information contained in past values of X_2 alone. Its mathematical formulation is based on linear regression modelling of stochastic processes. Thus, the Granger causality test in respect to this study is given as:

$$AGO_t = \sum \alpha_i COP_{t-1} + \sum \beta_i AGO_{t-1} + \mu_{t1} \ldots\ldots (10)$$
$$COP_t = \sum \lambda_i COP_{t-1} + \sum \sigma_i AGO_{t-1} + \mu_{t2} \ldots\ldots (11)$$
$$AGO_t = \sum \alpha_i RGDP_{t-1} + \sum \beta_i AGO_{t-1} + \mu_{t1} \ldots\ldots (12)$$
$$RGDP_t = \sum \lambda_i RGDP_{t-1} + \sum \sigma_i AGO_{t-1} + \mu_{t2} \ldots\ldots (13)$$
$$AGO_t = \sum \alpha_i INF_{t-1} + \sum \beta_i AGO_{t-1} + \mu_{t1} \ldots\ldots (14)$$
$$INF_t = \sum \lambda_i INF_{t-1} + \sum \sigma_i AGO_{t-1} + \mu_{t2} \ldots\ldots (15)$$
$$AGO_t = \sum \alpha_i EXCR_{t-1} + \sum \beta_i AGO_{t-1} + \mu_{t1} \ldots\ldots (16)$$
$$EXCR_t = \sum \lambda_i EXCR_{t-1} + \sum \sigma_i AGO_{t-1} + \mu_{t2} \ldots\ldots (17)$$
$$COP_t = \sum \alpha_i RGDP_{t-1} + \sum \beta_i COP_{t-1} + \mu_{t1} \ldots\ldots (18)$$
$$RGDP_t = \sum \lambda_i RGDP_{t-1} + \sum \sigma_i COP_{t-1} + \mu_{t2} \ldots\ldots (19)$$
$$COP_t = \sum \alpha_i INF_{t-1} + \sum \beta_i COP_{t-1} + \mu_{t1} \ldots\ldots (20)$$
$$INF_t = \sum \lambda_i INF_{t-1} + \sum \sigma_i COP_{t-1} + \mu_{t2} \ldots\ldots (21)$$
$$COP_t = \sum \alpha_i EXCR_{t-1} + \sum \beta_i COP_{t-1} + \mu_{t1} \ldots\ldots (22)$$
$$EXCR_t = \sum \lambda_i EXCR_{t-1} + \sum \sigma_i COP_{t-1} + \mu_{t2} \ldots\ldots (23)$$
$$RGDP_t = \sum \alpha_i INF_{t-1} + \sum \beta_i RGDP_{t-1} + \mu_{t1} \ldots\ldots (24)$$
$$INF_t = \sum \lambda_i INF_{t-1} + \sum \sigma_i RGDP_{t-1} + \mu_{t2} \ldots\ldots (25)$$
$$RGDP_t = \sum \alpha_i EXCR_{t-1} + \sum \beta_i RGDP_{t-1} + \mu_{t1} \ldots\ldots (26)$$
$$EXCR_t = \sum \lambda_i EXCR_{t-1} + \sum \sigma_i RGDP_{t-1} + \mu_{t2} \ldots\ldots (27)$$
$$INF_t = \sum \alpha_i EXCR_{t-1} + \sum \beta_i INF_{t-1} + \mu_{t1} \ldots\ldots (28)$$
$$EXCR_t = \sum \lambda_i EXCR_{t-1} + \sum \sigma_i INF_{t-1} + \mu_{t2} \ldots\ldots (29)$$

Where

AGO_t = Current value of Agricultural Output.

AGO_{t-1} = last value of Agricultural Output.

COP_t = Current value of Crude Oil Prices.

COP_{t-1} = last value of Crude Oil Prices.

$RGDP_t$ = Current value of Real Gross Domestic Product.

$RGDP_{t-1}$ = last value of Real Gross Domestic Product.

INF_t = Current value of Inflation rate.

INF_{t-1} = last value of Inflation rate.

$EXCR_t$ = Current value of Exchange Rate.

$EXCR_{t-1}$ = last value of Exchange Rate.

$\lambda_i, \sigma_i, \beta_i, \alpha_i$ = coefficients of the variables

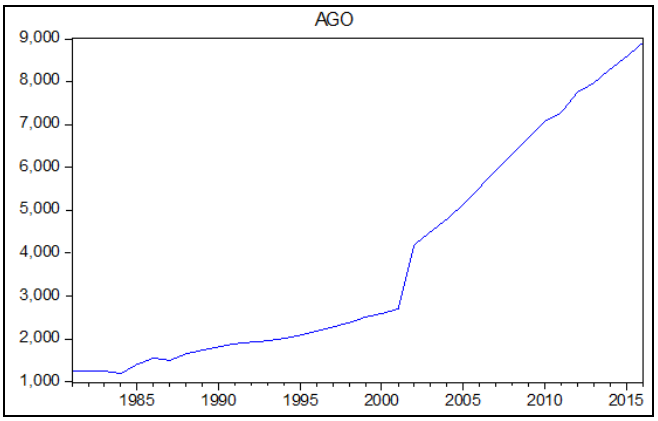
μ_t's = disturbance terms

4. Empirical results

4.1 Data Analysis

This section consists of the trend analysis, descriptive statistics, correlation analysis, unit root test, co-integration test, Vector Error Correction Mechanism test, Ordinary Least Square (OLS) estimation and Granger causality test.

4.2 Trend Analysis



Source: Authors computation using E-views 8.1

Fig 1: Agricultural output (AGO)

The Agricultural commodity output (AGO) of Nigeria is upward trended throughout the sample period. Between 2001 and 2002 with output of 2700 and 4199 respectively, the agricultural commodity output increases at a geometrical progression because there is an increase in the population growth which thus leads to increase in the demand for the commodity output.

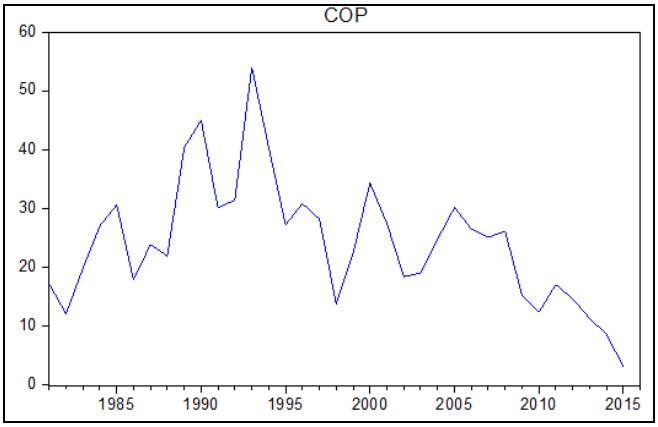


Fig 2: Crude Oil Prices (COP)

Crude Oil Prices (COP) is upward trended from 1981 up till 1993 and then it started to decline possibly this is due to the exploration and exploitation of crude oil by OPEC which makes it more available thereby making the crude oil prices at the international market to crash.

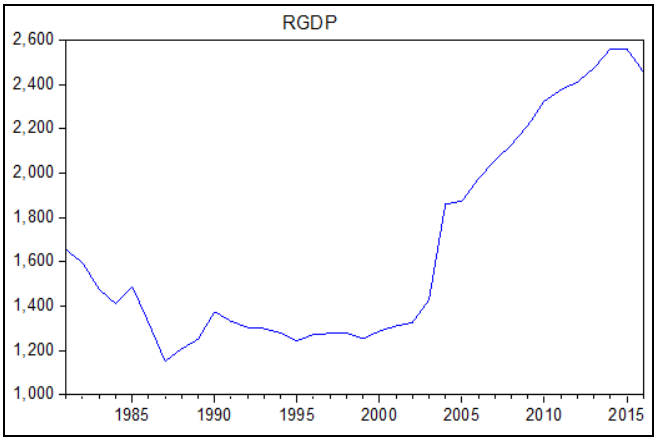


Fig 3: Real Gross Domestic Product (RGDP)

From 1981 to 1999, the Real Gross Domestic Product (RGDP) on Nigeria is downward trended. It then started increasing from 2000 and reaches its peak in 2014. The economic growth of Nigeria from 2015 started declining up till date due to political and economic instability.

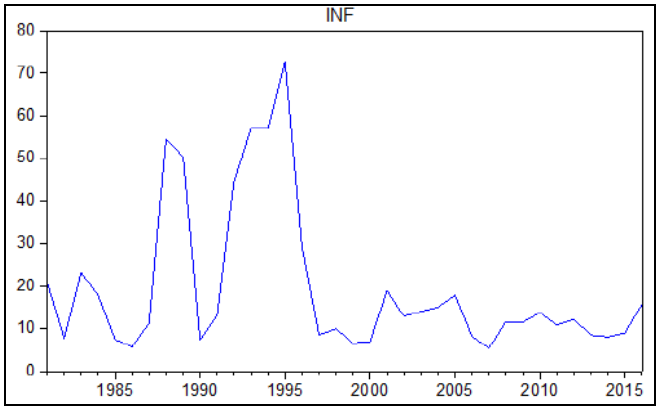


Fig 4: Inflation rate (INF)

Inflation rate (INF) is upward trended from 1981 up till 1995, where it reaches the peak. From 1995 up till 2014, the inflation rate is on a downward trend and it starts increasing from 2015 up till date possibly as a result of the increase in aggregate demand for goods and services.

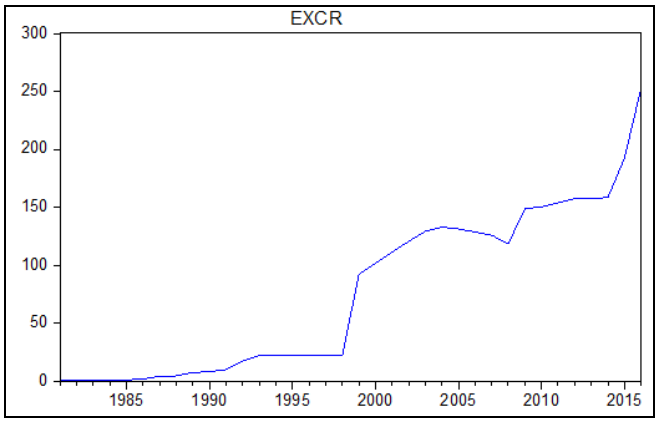


Fig 5: Exchange rate (EXCR)

The exchange rate of the economy Nigeria is upward trended all through from 1981 till date. In 1981 the exchange rate is recorded 0.617705 and at 2015 it is increase at 192.4405. The high increase in exchange rate is possibly due to the increase public debt, un favourable balance of payments and the political instabilities bedeviling the economy.

4.3 Correlation Analysis

In order to measure the linear relationship among the variables, a correlation analysis is conducted. The result of the correlation analysis is presented in table 1.

Table 1: Correlation Analysis Result

	AGO	COP	RGDP	INF	EXCR
AGO	1.000000	-0.542555	0.927424	-0.372284	0.932567
COP		1.000000	-0.585794	0.485333	-0.479484
RGDP			1.000000	-0.408246	0.797114
INF				1.000000	-0.408312
EXCR					1.000000

Source: Authors computation using E-views 8.1

From table 1 shows that there exists a negative correlation between Agricultural output (AGO) and Crude Oil Prices (COP). The result revealed that there is a strong positive correlation between Agricultural output (AGO) and Real Gross Domestic Product (RGDP). The result still shows that Agricultural output (AGO) and Exchange Rate (EXCR) are strongly positively correlated.

Furthermore, the correlation matrix shows that Real Gross Domestic Product (RGDP) and Exchange Rate (EXCR) are negatively correlated with Crude Oil Prices (COP). The Inflation rate (INF) and Exchange Rate (EXCR) also are negatively correlated with Crude Oil Prices (COP).

Finally, the result of the test shows that Inflation rate (INF) and Exchange Rate (EXCR) are negatively correlated.

4.4 Unit Root Test

Furthermore, a unit root test is also conducted mainly to test for the stationarity of the data. The unit root test id based on Augmented Dickey-Fuller (ADF) test.

Table 2: Unit Root Test

Variable	Position of Test	ADF Test	Critical Value At 5%	Order of Integration
AGO	At Level	-1.315252	-3.544284	I (1)
	At 1st Difference	-5.612103	-3.548490	
COP	At Level	-1.828628	-3.562882	I (1)
	At 1st Difference	-7.970462	-3.557759	
RGDP	At Level	-2.193109	-3.544284	I (1)
	At 1st Difference	-4.549226	-3.548490	
INF	At Level	-3.836192	-3.548490	I (0)
	At 1st Difference	-5.344402	-3.548490	
EXCR	At Level	-1.383627	-3.544284	I (1)
	At 1st Difference	-3.972837	-3.548490	

Source: Authors computation using E-views 8.1

From table 4, the unit root test recorded that Agricultural output (AGO), Crude Oil Prices (COP), Real Gross Domestic Product (RGDP) and Exchange Rate (EXCR) are not stationary at level because the absolute value of the ADF statistics are less than 5% critical values. However, they are stationary after the first difference, therefore, it is integrated of order one that is I (1), while Inflation (INF) is stationary at level because the absolute value of the ADF statistics is greater than the 5% critical value. Therefore, it is integrated of order zero, that is, I (0).

4.5 Johansen Co-Integration Analysis

Since most of the variables are not stationary at level, Johansen co-integration test is also conducted to determine the long run equilibrium relationship among the variables of interest.

Table 3: Johansen Co-Integration Test

Date: 12/16/18 Time: 00:44				
Sample (adjusted): 1983 2015				
Included observations: 33 after adjustments				
Trend assumption: Linear deterministic trend				
Series: AGO COP RGDP INF EXCR				
Lags interval (in first differences): 1 to 1				
Unrestricted Cointegration Rank Test (Trace)				
Hypothesized		Trace	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.645402	96.53577	69.81889	0.0001
At most 1 *	0.528938	62.32237	47.85613	0.0013
At most 2 *	0.508549	37.48111	29.79707	0.0054
At most 3	0.346258	14.03810	15.49471	0.0819
At most 4	0.000354	0.011697	3.841466	0.9136
Trace test indicates 3 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				
Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized		Max-Eigen	0.05	
No. of CE(s)	Eigenvalue	Statistic	Critical Value	Prob.**
None *	0.645402	34.21341	33.87687	0.0456
At most 1	0.528938	24.84126	27.58434	0.1079
At most 2 *	0.508549	23.44300	21.13162	0.0232
At most 3	0.346258	14.02641	14.26460	0.0545
At most 4	0.000354	0.011697	3.841466	0.9136
Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level				
* denotes rejection of the hypothesis at the 0.05 level				
**MacKinnon-Haug-Michelis (1999) p-values				

Source: Authors computation using E-views 8.1

The result in table 3 is the Johansen co-integration test result which shows that the trace statistic indicates three (3) co-integrating equations at the 5% level of significance and the maximum eigenvalue test indicates one co-integrating equation at the 5% level of significance. Therefore, there is long-run equilibrium relationship among Agricultural output (AGO), Crude Oil Prices (COP), Real Gross Domestic Product (RGDP), Inflation Rate (INF) and Exchange Rate (EXCR).

4.6 Vector Error Correction Mechanism

The Vector Error Correction Mechanism tries to correct the short-run disequilibrium of the variables. The error correction test is done to determine the percentage of the short-run disequilibrium that is corrected each year and also to know the speed of adjustment from short-run to long-run.

Table 4: Vector Error Correction Estimate Result

Vector Error Correction Estimates					
Date: 12/16/18 Time: 00:55					
Sample (adjusted): 1984 2015					
Included observations: 32 after adjustments					
Standard errors in () & t-statistics in [ ]					
Error Correction:	D(AGO)	D(COP)	D(RGDP)	D(INF)	D(EXCR)
CointEq1	-0.002112	4.26E-06	-3.11E-05	-4.47E-05	-3.29E-05
	(0.00039)	(1.5E-05)	(0.00014)	(3.2E-05)	(3.3E-05)
	[-5.48399]	[0.27827]	[-0.23014]	[-1.41520]	[-0.99398]
C	505.6138	-0.842765	-33.65899	3.223774	12.33063
	(82.8971)	(3.29539)	(29.1226)	(6.79011)	(7.12007)
	[6.09929]	[-0.25574]	[-1.15577]	[0.47477]	[1.73181]
R-squared	0.684500	0.552347	0.713744	0.391969	0.164128
Adj. R-squared	0.510975	0.306137	0.556303	0.057552	-0.295602
Sum sq. resids	729002.7	1152.032	89972.73	4891.077	5377.980
S.E. equation	190.9192	7.589573	67.07188	15.63822	16.39814
F-statistic	3.944674	2.243401	4.533404	1.172096	0.357009
Log likelihood	-205.9452	-102.7428	-172.4704	-125.8769	-127.3953
Akaike AIC	13.62157	7.171424	11.52940	8.617309	8.712209
Schwarz SC	14.17122	7.721075	12.07905	9.166960	9.261860
Mean dependent	228.8809	-0.523869	33.93303	-0.443583	5.991129
S.D. dependent	273.0134	9.111303	100.6925	16.10863	14.40651
Determinant resid covariance (dof adj.)		2.63E+14			
Determinant resid covariance		2.51E+13			
Log likelihood		-720.6707			
Akaike information criterion		49.10442			
Schwarz criterion		52.08169			

***Source*:** Authors computation using E-views 8.1

Based on the result of the Vector Error Correction mechanism presented in table 4 the result suggests that about 2% of short-run disequilibrium is corrected by Agricultural Output (AGO). About 26% of short-run disequilibrium is corrected by Crude Oil Prices (COP). Real Gross Domestic Product (RGDP) corrected for about 11% of short-run disequilibrium, however, 47% of short-run disequilibrium is corrected by Inflation Rate (INF), while about 29% of short-run disequilibrium is corrected by Exchange Rate annually.

4.7 Ordinary Least Square (OLS) Results

Ordinary Least Squares method is used to estimate the impact of Dutch disease on agriculture in Nigeria. The e-views output of the regression analysis is presented in table 5.

Table 5: Ordinary Least Square (OLS) Result

Dependent Variable: AGO				
Method: Least Squares				
Date: 12/16/18 Time: 01:06				
Sample (adjusted): 1981 2015				
Included observations: 35 after adjustments				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-2338.999	590.9162	-3.958258	0.0004
COP	-3.032610	10.22678	-0.296536	0.7689
RGDP	2.717571	0.321218	8.460203	0.0000
INF	9.035303	5.460007	1.654815	0.1084
EXCR	20.31394	2.110140	9.626817	0.0000
R-squared	0.965804	Mean dependent var		3692.424
Adjusted R-squared	0.961245	S.D. dependent var		2468.553
S.E. of regression	485.9696	Akaike info criterion		15.34173
Sum squared resid	7084994.	Schwarz criterion		15.56393
Log likelihood	-263.4803	Hannan-Quinn criter.		15.41843
F-statistic	211.8238	Durbin-Watson stat		0.856184
Prob(F-statistic)	0.000000			

Source: Authors computation using E-views 8.1

From table 5, the OLS regression result revealed that Inflation rate (INF) and Exchange Rate (EXCR) are contrary to a priori expectation stated initially in chapter three of this work while Crude Oil Prices (COP) and Real Gross Domestic Product (RGDP) on the other hand are in agreement with the a priori expectations.

The regression result reveals that the value of the constant (β_0) is -2338.999. This indicates that should all the independent variables are held constant; the value of Agricultural output (AGO) will be -2338.999.

The OLS result shows that Crude Oil Prices (COP) with a coefficient of -3.032610 has a negative impact on the Agricultural output (AGO). This means that holding other variables constant, a unit increases in Crude Oil Prices (COP) will result to a decline in Agricultural output (AGO) by 3.032610.

The result further indicates that Real Gross Domestic Product (RGDP) with a positive coefficient of 2.717571, this implies that holding other variables constant, a unit increase in Real Gross Domestic Product (RGDP) will leads to an increase in Agricultural output (AGO) by 2.717571.

Furthermore, the Ordinary Least Square (OLS) results shows that Inflation rate (INF) has a positive coefficient of 9.035303, this means when other variables are held constant, an increase in Inflation rate will leads to an increase in Agricultural output (AGO) by 9.035303.

Finally, the result indicates that the Exchange rate (EXCR) is of positive coefficient of 20.31394, this implies that whenever there is a unit increase in the Exchange rate (EXCR) it increases Agricultural output (AGO) by 20.31394. That is when all other variables are held constant.

The R-Squared (R^2) measures the goodness of fit of the regression model. From 5, the value of R-Squared (R^2) that is the coefficient of determination is 0.965804. This value implies that Crude Oil Prices (COP), Real Gross Domestic Product (RGDP), Inflation rate (INF) and Exchange Rate (EXCR) can be relied on to explain 96.58% of the variations in Agricultural output (AGO) while the remaining 3.42% is explained by the disturbance term (μ_t) that is other variables that are that are not featured in this the model.

Furthermore, as a rule of thumb the Durbin-Watson Statistic runs from 0 to 4. And any value close to the central value of 2 indicates the absence of serial autocorrelation while any value far to the left or right indicates the presence of negative or positive. Thus, the Durbin-Watson Statistic is 0.856184 which indicates the presence of negative serial autocorrelation.

4.8 Granger Causality Tests

To determine the causal relationship among the variables, the granger Causality is conducted. The result of the Granger Causality test is presented in table 6.

Table 6: Granger Causality Tests

Pairwise Granger Causality Tests			
Date: 12/16/18 Time: 01:21			
Sample: 1981 2016			
Lags: 2			
Null Hypothesis:	Obs	F-Statistic	Prob.
COP does not Granger Cause AGO	33	0.35842	0.7019
AGO does not Granger Cause COP		4.21484	0.0251
RGDP does not Granger Cause AGO	34	1.09961	0.3465
AGO does not Granger Cause RGDP		8.92672	0.0010
INF does not Granger Cause AGO	34	0.38207	0.6858
AGO does not Granger Cause INF		1.46712	0.2472
EXCR does not Granger Cause AGO	34	9.66070	0.0006
AGO does not Granger Cause EXCR		1.17665	0.3226
RGDP does not Granger Cause COP	33	5.15668	0.0124
COP does not Granger Cause RGDP		0.63897	0.5354
INF does not Granger Cause COP	33	6.02330	0.0067
COP does not Granger Cause INF		3.82589	0.0340
EXCR does not Granger Cause COP	33	4.26993	0.0241
COP does not Granger Cause EXCR		1.69928	0.2011
INF does not Granger Cause RGDP	34	0.30239	0.7414
RGDP does not Granger Cause INF		1.50855	0.2381
EXCR does not Granger Cause RGDP	34	6.82168	0.0037
RGDP does not Granger Cause EXCR		0.49282	0.6159
EXCR does not Granger Cause INF	34	1.70470	0.1995
INF does not Granger Cause EXCR		0.64693	0.5310

Source: Authors computation using E-views 8.

The granger causality test from table 6 above shows the causal relationship between Agricultural Output (AGO), Crude Oil Prices (COP), Real Gross Domestic Product (RGDP), Inflation rate (INF) and Exchange rate (EXCR).

The Granger causality result shows that Crude Oil Prices (COP) does not Granger caused Agricultural Output (AGO) because the null hypothesis cannot be rejected at the 5% level of significance. While the Agricultural Output (AGO) Granger caused Crude Oil Prices (COP) because the null hypothesis is rejected at the 5% level of significance. Thus, there is a unidirectional causality between the Crude Oil Prices (COP) and the Agricultural Output (AGO).

Also, the Real Gross Domestic Product (RGDP) does not Granger caused Agricultural Output (AGO) because the F-statistical probability value (0.3465) is insignificant at 5% level while Agricultural Output (AGO) Granger caused Real Gross Domestic Product (RGDP) because it has a significant F-statistical probability value (0.0010) at the 5% level. So, there exists a unidirectional causality between the Real Gross Domestic Product (RGDP) and Agricultural

Output (AGO).

From the result above, Inflation rate (INF) does not Granger caused Agricultural Output (AGO) and Agricultural Output (AGO) other hand does not Granger caused Inflation rate (INF) because their F-statistical probability values (0.6858 and 0.2472) are insignificant at 5% level. Therefore, there is no causal relationship between Inflation rate (INF) and Agricultural Output (AGO).

The Exchange rate (EXCR) Granger caused Agricultural Output (AGO) because the F-statistical probability value (0.0006) is significant at the 5% level of significance but the Agricultural Output (AGO) does not Granger caused Exchange rate (EXCR) for the F-statistical probability value is insignificant at the 5% level. Hence, a unidirectional causality between Exchange rate (EXCR) and Agricultural Output (AGO) exists.

There is a unidirectional causality between the Real Gross Domestic Product (RGDP) and Crude Oil Prices (COP) because the Real Gross Domestic Product (RGDP) Granger caused Crude Oil Prices (COP) due to a significant F-statistical probability value at the 5% level and on the other hand, Crude Oil Prices (COP) does not Granger caused Real Gross Domestic Product (RGDP) since the F-statistical probability value is insignificant at the 5% level.

The result shows that Inflation rate (INF) Granger caused Crude Oil Prices (COP) and Crude Oil Prices (COP) also Granger caused Inflation rate (INF) because their F-statistical probability values (0.0067 and 0.0340 respectively) are both significant at the 5% level. So, there is a bidirectional relationship between Inflation rate (INF) and Crude Oil Prices (COP).

Furthermore, Exchange rate (EXCR) Granger caused Crude Oil Prices (COP) and Crude Oil Prices (COP) because the F-statistical probability value of 0.0241 is significant at 5% level while Crude Oil Prices (COP) does not Granger caused Exchange rate (EXCR) because the F-statistical probability value of 0.2011 is not significant at the 5% level. Thus, these show that there is a unidirectional causality between the Exchange rate (EXCR) and the Crude Oil Prices (COP).

There is no causal relationship between Inflation rate (INF) and Real Gross Domestic Product (RGDP) because Inflation rate (INF) does not Granger caused Real Gross Domestic Product (RGDP) and Real Gross Domestic Product (RGDP) also does not Granger caused Inflation rate (INF) since their F-statistical probability values (0.07414 and 0.2381 respectively) are insignificant at the 5% level.

Exchange rate (EXCR) Granger caused Real Gross Domestic Product (RGDP) because the F-statistical probability value is significant at the 5% and Real Gross Domestic Product (RGDP) does not Granger caused Exchange rate (EXCR) because the F-statistical probability value is insignificant at the 5% level. Therefore, there is a unidirectional causality between Exchange rate (EXCR) and Real Gross Domestic Product (RGDP).

Finally, Exchange rate (EXCR) does not Granger caused Inflation rate (INF) and Inflation rate (INF) also does not Granger caused Exchange rate (EXCR) because their F-statistical probability values are insignificant at the 5% level and hence, there is no causal relationship between Exchange rate (EXCR) and Inflation rate (INF).

5. Conclusion and Recommendations

Having analysed the empirical evaluation of the impact of Dutch disease in Nigeria from 1981 to 2018, we conclude that Crude Oil Prices (COP) has a negative impact on the Agricultural output (AGO). This means that an increase in Crude Oil Prices (COP) will make agricultural product uncompetitive for export and therefore discourage agricultural development in the country.

In light of the above findings, the following recommendations are therefore proposed:

The discovery of a primary material should not be seen as a means to abandon other relevant and important sectors of the economy; therefore, the Nigerian Government should not only concentrate on a single growing sector (Oil sector), but should diversify the economy to other productive non-oil sectors. This should be done because diversification of an economy increases investment in the economy as more and more sectors of the economy are brought into focus with widening economic activities.

There is utmost need for the Policy-makers to give attention to the agricultural sector by providing loans and subsidies to farmers. Thus, this non-oil export sector should also concentrate on having competitive advantage rather than depending on price competitiveness through government subsidies, as this effort will steadily rescue the economy to economic excellence.

Finally, proceeds from oil should be used optimally to develop the agricultural sector. This will go a long way in reducing dependency on the oil sector and will boost the agricultural sector.

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