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DETERMINANTS OF PRIVATE SECTOR GROWTH IN NIGERIA, 1981 - 2020

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ABSTRACT: *This study examines and analyses the determinants of private sector growth in Nigeria. The dependent variable is Private Sector Growth (PSG) and the independent variables are Real Gross Domestic Product (RGDP), Interest Rate (INTR), Per Capita Income (PCI), Inflation Rate (INFR), Exchange Rate (EXR), Broad Money Supply (BMS). The data for the study were sourced from CBN Statistical Bulletin, 2019 / 2020 edition from 1981 to 2020. The study employed Cointegration and Error Correction Mechanism as the main analytical tool. It also applied the unit root test and results showed that the data were integrated at order one while the long-run relationship among the variables was confirmed using the Johansen (1988) cointegration test. Estimates of the Error Correction Model result showed that Interest Rate (INTR), Exchange Rate (EXR) have a negative significant relationship with the determinants of private sector growth in Nigeria, Broad Money Supply (BMS) has a negative significant relationship with the determinants of private sector growth in Nigeria. In conclusion from the above results, it was observed that the determinants of the private sector growth in Nigeria contributed to the improvement and enhancement of Interest Rate, Exchange Rate and Broad money Supply in Nigeria. It was recommended that interest rate, exchange rate and broad money supply have a significant positive and negative relationship between interest rate, exchange rate and broad money supply with the determinants of private sector growth in Nigeria base on this result: it is recommended that continued attraction of real sector development from private investors would boost economic growth in Nigeria. And also to develop human capital for Nigeria would be to put in place policies and infrastructures that could encourage private investment inflows.*

KEYWORDS: Private Sector Growth, Unit root test, Johansen Cointegration test, Error Correction Model, Nigeria.

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INTRODUCTION

Private sector development involves the improvement of the investment climate which is crucial for sustaining and expanding businesses, stimulating economic growth and has been the backbone of most developed and developing economies. The private sector is recognized as a critical stakeholder and partner in economic development, by helping people escape poverty through the provision of jobs and income, as well as the availability of necessary goods and services needed to enhance people's standard of living (International Finance Corporation, 2011).

In addition, the rapid growth of the service economy has generated a lot of interest in the study of service. These service-related economic activities for the developed countries account for over 75% of their gross domestic product, as service orientation is also becoming increasingly evident in developing economies as well Masud et al (2018).

Also, investments are significant for the progress of a country and play a constructive part in economic growth. Many developing countries depend on investment to address economic problems such as financial imbalance, the balance of payment, debt, poverty, and unemployment. Investment can be defined as the expenditures on capital goods to increase the productive capacity, with the aim to produce more goods and services and get a better payoff in future (Kartikasari, 2017).

Banks as financial institutions play very important roles in the economic development and growth of any country. They channel scarce resources from the surplus economic units to the deficit economic units in an economy. They provide loans to deficit units in the form of short-term, medium-term and long-term credit. Bank credits, to a reasonable extent, exert reasonable influence on the pattern and trend of economic growth in Nigeria Gbenga et al (2019).

Ogbonna (2020), opined that Nigerian entrepreneurs under the auspices of the Business Founders Coalition appealed to the Nigerian President over what they considered hostile takeover bids of foreign private equity firms on their businesses there are some who come into Nigeria literally to hijack the indigenous-owned companies. This may be regarded as a consensus opinion held by local business operators about the negative effect of unchecked globalization on the local economy and of the need to protect domestic industries. Essentially, the group urges the government to put in place policies that do not allow a foreign investor to have controlling rights in a Nigerian business.

The specific objectives of the study are to determine how a real gross domestic product is related to private sector growth in Nigeria, ascertain the impact of interest rate on private sector growth in Nigeria, determine how per capita income relate to private sector growth in Nigeria, ascertain the relationship between inflation rate and private sector growth in Nigeria, determine how the exchange rate is related to private sector growth in Nigeria, ascertain how broad money supply relates to private sector growth in Nigeria. The following hypotheses which are stated in the null form are tested in this research study: H_{01}: Real gross domestic product is not significantly related to private sector growth in Nigeria, H_{02}: Interest rate has no significant impact on private sector growth in Nigeria, H_{03}: Per capita income does not have a significant relationship with private sector growth in Nigeria, H_{04}: Inflation rate does not have a

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significant relationship with private sector growth in Nigeria, H_{05}: Exchange rate is not significantly related to private sector growth in Nigeria, H_{06}: Broad money supply is not significantly related to private sector growth in Nigeria.

LITERATURE REVIEW

Theoretical Framework

Basic Theories

A. Acceleration Theory on Private Sector Investment

The Keynesian accelerator model was postulated by Keynes (1936). In its simplest version propounded by Clark (1917), the model avers that there exists an optimum quantity of real capital for a given level of output. Thus, larger stocks of capital held by firms are necessitated by high demand. In this theory, net investment expenditures equal the change in the level of real capital and thus net investment is proportional to the expected change in output. Gross investment requires the incorporation of replacement capital or depreciation. The basic argument of the flexible-accelerator principle is that when the gap between the existing capital stock and the desired capital stock is substantial, the firms' rate of investment will be high. The hypothesis, as highlighted by Chirinko (1993); is that firms plan to close a fraction of the gap between the desired capital stock and actual capital stock in each period. Investment is determined from the difference between the desired level of capital and the capital that survives from the past. The capital that survives from the past is a constant proportion of past capital. The accelerator theory is based on an assumption of a stable (or fixed) capital to output ratio.

B. Classical Theory on Private Sector Investment

Barro (1997), distinguishes the two ways in which private sector investment can be displaced as arising from a tax cut or an increase in government consumption spending. This induces increased public debt which he describes as; the decline in private investment that may result from a tax cut financed by a government budget deficit and the decrease in private consumption and investment that result from an increase in government consumption respectively.

In the classical frame, several other factors are seen to influence the behaviour of private sector investment; such as the public debt structure, its maturity and composition of ownership. Maana *et al*., (2008) noted that the composition of public domestic debt portfolios influences how investment in the private sector can access credit.

Christensen (2005), argued that a narrow investor base consisting mainly of commercial banks increases the risk that as government securities are sold, private companies dependent mainly on commercial bank financing will lose out in the absence of non-bank investors, such as pension funds and retirement funds, to which the government could sell its debt without necessarily displacing private sector investment.

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C. Keynesian Theory on Private Sector Investment

Keynesians believe that governments are justified to stimulate economic growth through the use of deficit causing fiscal policy. They assume that the economy is not at full employment and that the interest rate sensitivity of investment is low. In such a situation, increased government spending causes **a** minimal increase in the interest rate whilst increasing output and income. Furthermore, they argued government expenditure increases private investment due to the positive effect of government spending on the expectations of the investors. Their argument is based on the principle of the multiplier where a change in government spending induces a greater change in output.

D. Neo-Classical Approach to Private Sector Development

Proponents of the neoclassical approach to the business enable the environment to assume that most factor markets work reasonably well without government intervention if property rights and competition are guaranteed. Such interventions are in most cases considered less efficient than market-based solutions, and it is stressed that many government interventions in fact hamper private sector development. Measures to improve the business enabling environment consequently focus on deregulation and the good functioning of markets, with only a limited role assigned to the public sector in a few areas where market failure is most obvious. Proponents of this approach do not take the characteristics and motives of the entrepreneur into account. Instead, the distinguishing attribute of informal firms is non-registration. It is assumed that the informal economy consists of enterprises that operate informally because the costs, time and effort of formal registration are too high (de Soto 1989; and Palmade & Anayiotos 2005).

E. The Neo-Structuralist Approach to Private Sector Development

A proponent of the neo-structuralist interpretation, Chen (2004) distinguished a “structuralist’’ and a “dualist’’ school of thought. In the dualist version, formal and informal modes of production are largely unconnected, whereas in the structuralist version the informal economy is subordinated to large capitalist firms of the informal economy. Also, Tokman (1990) argued that the informal economy consists of marginal activities that provide income for the poor and a safety net when no formal employment opportunities are available. Viewed from this perspective, multiple deficiencies, beyond insecure property rights and red tape, hamper the development of informal enterprises. Among these deficiencies are lack of education and technical and management training and limited access to capital and markets. Most owners of informal micro-enterprises are necessity entrepreneurs who run their business as an activity of last resort in the absence of employment alternatives. The informal economy absorbs a segment of the labour force that is not easily employable in the modern economy. For example, people with low levels of education, handicapped, ill and elderly people, single mothers who need to care for their children during the day as well as temporarily unemployed persons. Opportunities for self-employment or the formation of micro-enterprises are largely restricted to activities with low entry barriers in terms of skills and capital (e.g. street trading, garment manufacture). Labour supply in these activities tends to be high, creating cutthroat competition with low returns and often decreasing productivity. The observation that the informal economy often grows during recessions suggests that it comprises a workforce with limited employability rather than being a seedbed for thriving future entrepreneurs.

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F. The Tobin q Theory

The q theory was postulated by Tobin & Brainard (1968), however, the use of the letter "q" did not materialise until Tobin's 1969 article "A general equilibrium approach to the monetary theory". Tobin hypothesised that the combined market value of all the companies on the stock market should be equal to their replacement costs. In the Tobin q theory of investment, the ratio of the market value of the existing capital stock to its replacement cost (the q ratio) is the main force driving investment (Chirinko, 1993; Ghura & Godwin, 2000). That is to say, enterprises will want to invest if the increase in the market value of an additional unit exceeds the replacement cost (Ajide & Lawanson, 2012).

G. The Neoliberal Approach

The neoliberal approach, popularised by McKinnon (1973) and Shaw (1973) is another theory that attempts to explain investment behaviour. The theory posits that developing countries suffer from financial repression and if they were liberated from this problem, saving would be induced, and eventually, growth. Liberalisation is crucial in this theory. With liberalisation, both savings and loanable funds will increase, resulting in a more efficient allocation of funds with a potential contribution to higher economic growth. Unlike the neoclassical theory, in this theory investment is positively related to the real rate of interest. The reason for this is that a rise in interest rates increases the volume of financial savings through financial intermediaries and thereby raises investible funds, a phenomenon that McKinnon (1973) and Shaw (1973) referred to as the "conduit effect". Thus, while it may be true that demand for investment declines with the rise in the real rate of interest, realised investment actually increases because of the greater availability of funds. This conclusion applies only when the capital market is in disequilibrium with the demand for funds exceeding supply (Asante, 2000). Neoliberalists identify interest rates as the main determinant of investment. According to this theory interest rates have a positive effect on investment, however, this is in contrast with both the q theory and the neoclassical theory of investment that suggest a negative effect of interest rates on investment.

Empirical Literature Review

Several studies have examined determinants of private sector growth in Nigeria in both developed and developing nations although only a few of them are done in Nigeria. However, some of these studies are presented here empirically to provide guides and directions to the model of this present study.

Manda (2019), assessed the impact of government borrowing on the private sector credit in Zimbabwe using monthly data from 2012 to 2018 using a multivariate regression model and an unrestricted Vector Auto-regression (VAR) confirms a negative but not significant relationship between credit to government and credit to the private sector, implying that credit to the government may not have crowded out private credit.

Nwakanma, et al. (2014), evaluated the nature of the long-run relationship existing between bank credits to the private sector and economic growth in Nigeria for the period of 1981-2011 by using ARDL and Granger causality techniques. The result indicated that there is a significant long-run relationship between bank credit to the private sector and economic growth but there is no significant causality in any direction.

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Attefah and Enning (2016) looked into the determinants of private investment from 1980-2010 in the case of Ghana. The coefficients determined by the multiple regression model show that credit availability, government investment, the openness of the economy, external debt, democracy, and corporate tax significantly affect private investment. The study recommends that the crowding-out effect can be diminished by having a tighter fiscal policy.

Moshi and Kilindo, (2017), considered the effect of government policy on private investment over the 2000-2015 periods in Tanzania. Regression results from the ordinary least squares estimation technique among others showed that the real exchange rate had a negative and significant effect, indicating that devaluation reduced the profitability of private investment in the Tanzanian economy during the study period.

Abubakar et al (2019), used a Structural Vector Autoregressions (SVAR) and model to analyse the dynamics of government borrowing behaviour on the growth of the private sector in Nigeria provided evidence that government borrowing behaviour has the propensity of impacting negatively on the effectiveness of private sector growth in Nigeria.

Bonga and Nyoni (2017), systematically reviewed the determinants of private investment which has been significantly low for the past three decades in Zimbabwe. Their results showed that GDP and public investment are the most powerful factors that affect private investment in Zimbabwe. The study recommended that gross domestic product, public investment, interest rate and other macroeconomic indicators used in the study should be improved upon to have a productive effect on the private sector investment.

Oyedokun and Ajose (2018), examined and understood the vital link between domestic private businesses and Nigerian economic progress by employing the causality Granger test and Vector ECM model from 1980-2016. The outcome of their analysis revealed that a long run significant relationship exists with domestic private business granger causing the growth of the real GDP at all levels.

Oshikoya (1994), carried out a study on the macroeconomic determinants of private investment using a sample of seven African countries for the period 1970-1988. The results indicate that private investment is positively related to public sector investment and real interest rates for middle-income countries. For the low-income countries, the results showed a significantly negative relationship between private investment and inflation rate, but the negative relationship between private investment and the real exchange rate was rather insignificant. The result, however, shows that the availability of accessible domestic credit to the private sector has a positive and significant impact on the level of private investment activities in both low-income and high-income countries.

METHODOLOGY

Annual Time Series Data covering the period of 1981 to 2020 which were obtained from the CBN Statistical Bulletin 2019 Edition Updated to 2020 were used in this study. Augmented Dickey-Fuller (ADF) unit root test was conducted and the result necessitated the test for the long-run relationship among the variables (co-integration) using the Johansen Cointegration test approach, as specified in Granger and Newbold (1977). The model coefficients were

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estimated using the Error Correction Model technique and granger causality was adopted as well.

Theoretical Framework

The study adopts the models in Oshikoya (1994); and Ghura and Godwin (2000) but with modifications due to the non-inclusion of some relevant explanatory variables based on the accelerator model. The explanatory variables in this study are Real Gross Domestic Product (RGDP), Interest Rate (INTR), Per Capita Income (PCI), Inflation Rate (INFR), Exchange Rate (EXR), Broad Money Supply (BMS), whereas the dependent variable is Private Sector Growth (PSG) were used in this study. The data used in the analysis is secondary annual time-series data of six variables which were obtained from the CBN Statistical Bulletin 2019 Edition Updated to 2020 the time period covered in this study is 39 years (1981 to 2020). Using Augmented Dickey-Fuller (ADF) unit root test was conducted and the result necessitated the test for the long-run relationship among the variables (co-integration) using the Johansen Cointegration test approach, as specified in Granger and Newbold (1977). The model coefficients were estimated using the Error Correction Model technique and granger causality was adopted as well.

Model Specification

The model which hypothesised variations in private sector growth to be a function of the explanatory variables is algebraically specified. The model is specified based on acceleration theory.

Model

$$PSG = f(RGDP, INTR, PCI, INFR, EXR, BMS) \quad (3.1)$$

The parameterized version of the private sector growth model is presented as

$$PSG_t = \beta_0 + \beta_1 RGDP_t + \beta_2 INTR_t + \beta_3 PCI_t + \beta_4 INFR_t + \beta_5 EXR_t + \beta_6 BMS_t + \mu_t) \quad (3.2)$$

Where the variables are as itemised above; β_0 is the constant while $\beta_1 \ldots \beta_6$ are the coefficient of the parameters; t is a subscript denoting time. Based on a priori, $\beta_1 > 0, \beta_2 < 0, \beta_3 > 0, \beta_4 < 0, \beta_5 < 0, \beta_6 > 0$.

Variables in the model:

PSG means Private Sector Growth measured as (N' Billion)

RGDP means Real Gross Domestic Product measured as (N' Billion)

INTR means Interest Rate measured as (Rate)

PCI means Per Capital Income measured as ('000 Naira)

INFR means Inflation Rate measured as (%)

EXR means Exchange Rate measured as (Naira to Dollar)

BMS means Broad Money Supply measured as (N' Billion)

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The theoretical relationship between private sector growth and the real gross domestic product is found to be negative/positive and insignificant. while the relationship between private sector growth and interest rate is found to be negative and insignificant and significant. That of the relationship between private sector growth and per capita income is found to be negative/positive and insignificant. Also, the relationship between private sector growth and the inflation rate is found to be negative and insignificant. Then, the relationship between private sector growth and the exchange rate is found to be negative and insignificant/significant. As well, the relationship between private sector growth and broad money supply is found to be negative/positive and insignificant/significant.

Estimation Technique and Procedure

Test for Unit Root:

The presence of trends and unit-roots are detected from the slowly decaying autocorrelation function in a univariate process which indicates non-stationarity. Consider $AR_{(p)}$ model so that

$$Y_t = \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + ... + \phi_p Y_{t-p} + \varepsilon_t \text{ which can be written as}$$

$$\psi(L) y_t = \varepsilon_t \qquad (3.3)$$

where $\psi(L) = 1 - \phi_1 L - \phi_2 L^2 - ... - \phi_2 L^2$ is a polynomial in lag L.

If the root of the characteristic equation $\psi(L) = 0$ are all greater than unity in absolute term, then y_t is stationary, otherwise y_t is non-stationary.

Dickey-Fuller test:

The Dickey-Fuller test affirms if $\phi = 0$. In this model of the data $y_t = \beta_t + \phi y_{t-1} + e_t$, which is written as $\Delta y_t = y_t - y_{t-1} = \beta_t + \gamma y_{t-1} + e_t$. It is written this way so we can perform a linear regression of Δy_t against t and y_{t-1} and test if γ is different from 0. If $\gamma = 0$, then we have a random walk process. If not and $-1 < 1 + \gamma < 1$, then we have a stationary process. Given the model

$$y_t = \beta y_{t-1} + \varepsilon_t \qquad (3.4)$$

Subtracting y_{t-1} from both sides, we have

$$y_t - y_{t-1} = \beta y_{t-1} - y_{t-1} + \varepsilon_t$$
$$\Rightarrow \Delta y_t = (\theta - 1) y_{t-1} + \varepsilon_t$$
$$= \delta y_{t-1} + \varepsilon_t \qquad (3.5)$$

Testing for $\theta = 1$ is equal to testing for $\delta = 0$

The following regression equations and the associated error terms are considered for the unit root test:

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$$\Delta y_t = \delta y_{t-1} + \varepsilon_t \quad (3.6)$$

$$\Delta y_t = \beta_0 + \delta y_{t-1} + \varepsilon_t \quad (3.7)$$

$$\Delta y_t = \beta_0 + \delta y_{t-1} + \beta_1 t + \varepsilon_t \quad (3.8)$$

Augmented Dickey-Fuller (ADF) test:

The ADF test belongs to a category of tests called 'Unit Root Test', which is the proper method for testing the stationarity of a time series. The Augmented Dickey-Fuller test checks through these models:

$$\Delta y_t = (\rho - 1) y_{t-1} + \sum_{j=1}^{n} \beta_j \Delta y_{t-j} + \varepsilon_t \quad (3.9)$$

$$\Delta y_t = \alpha + (\rho - 1) y_{t-1} + \sum_{j=1}^{n} \beta_j \Delta y_{t-j} + \varepsilon_t \quad (4.0)$$

$$\Delta y_t = \alpha + \delta_t + (\rho - 1) y_{t-1} + \sum_{j=1}^{n} \beta_j \Delta y_{t-j} + \varepsilon_t \quad (4.1)$$

Hypotheses Tests are specified as :

$H_0 : \rho = 1 \quad vs \quad H_1 : \rho < 1$

$H_0 : \alpha = 0 \quad vs \quad H_1 : \alpha \neq 0$

$H_0 : \gamma = 0 \quad vs \quad H_1 : \gamma \neq 0$

The test statistic is specified as :

$T_\rho = \dfrac{\hat{\rho}}{S.E.(\hat{\rho})}$ □ $ADF(I, n, \alpha)$ *is compared with the appropriate value of Dickey Fuller table*

The null hypothesis for the tests is that the data are non-stationary, and it is rejected for this test so we want a p-value of less than 0.05.

Co-integration

Co-integration studies the long-run equilibrium in multivariate non-stationary time series. A multivariate process that is non-stationary by differentiation and the resulting series can be modelled by univariate techniques. Even though it is possible to treat all processes in the same manner before carrying out further analysis, it is not so straightforward in a multivariate case. The modern approach is to have a stationary linear combination of non-stationary variables, and such variables are said to be co-integrated (Shittu and Yahaya, 2011).

The Co-integration technique analyses the joint movement of economic variables and their departure from equilibrium overtime. It expresses the relationship that exists between two non-stationary series for which the stochastic relationships are bounded. Its emphasis is on the following:

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(a) It establishes a link between two non-stationary series by obtaining a linear combination that gives integration of order zero [I(0,1)].

(b) It helps to establish relationships among non-stationary series such that the relationship is reasonable, sensible and of statistical importance.

(c) It specifies the Error Correction Model (ECM).

The Co-integration test is performed in this study using Johansen methodology which offers two tests for testing the number of cointegrating relationships: the trace test and the eigenvalue test. The trace test tests the null hypothesis that there are at most r co-integrating relationships. That is, rejecting the null means that there are more than r co-integrating relationships. The test itself computes the trace statistic and compares it with critical values. Critical values have been computed by several different sources, including Johansen himself. The trace test rejects the null if the trace statistic exceeds the critical value.

The eigenvalue test tests the null hypothesis of r versus r + 1 co-integrating relationships. The test rejects the null hypothesis if the eigenvalue test statistic exceeds the respective critical value T.

Consider two economic series X_t and Y_t such that their co-movement is described as

$$Y_t = \beta X_t = w_t \qquad (4.2)$$

$$Y_t = \alpha X_t = \varepsilon_t \qquad (4.3)$$

$$where\ w_t = w_{t-1} + \varepsilon_{1t}$$

$$\varepsilon_t = \rho\varepsilon_{t-1} + \varepsilon_{1t}$$

From equation (4.3),

$$X_t = \frac{\varepsilon_t - Y_t}{\alpha} \qquad (4.4)$$

Substituting (4.4) in (4.3) to have

$$Y_t = w_t - \beta X_t$$

$$= w_t - \frac{\beta(\varepsilon_t - Y_t)}{\alpha}$$

$$=> \alpha Y_t = \alpha w_t - \beta\varepsilon_t + \beta Y_t$$

$$=> Y_t = (\alpha - \beta) = \alpha w_t - \beta\varepsilon_t$$

$$=> Y_t = \alpha(\alpha - \beta)^{-1} w_t - \beta(\alpha - 1)^{-1}\varepsilon_t \qquad (4.5)$$

Thus $\{Y_t\}\ and\ \{X_t\}$ are linearly dependent on w_t and the cointegrating vector is (1: α), the long-run equilibrium.

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Johansen Procedure

Testing for cointegration in the multivariate case amounts to determining the rank of a series, π, where we effectively need to determine the number of non-zero eigenvalues in π. Johansen (1988) established a novel method for determining the number of eigenvalues in a maximum likelihood framework. It suggests that one should order the eigenvalues such that $\lambda_1, \lambda_{2,,...}, \lambda_n$ where $\hat{\lambda}_1$ is the first eigenvalue. To test the null hypothesis that there are at most r co-integrating vectors that would then amount to testing, $H_0: \hat{\lambda}_i = 0 \text{ for } i = r + 1,\ldots, n$, where only the first r eigenvalues are non-zero. For instance, if n = 2 and r = 1 as in the first example, the first eigenvalue, $\hat{\lambda}_1$ will be non-zero and the second $\hat{\lambda}_2$ will be zero.

In the three variable cases, when n = 3 and r = 2, the first two eigenvalues are non-zero and the third, $\hat{\lambda}_3$ is zero. By adding more variables, this pattern will continue until n = r. Therefore, when the series has rank zero, then there is no long-run relationship, so all the eigenvalues are equal to zero.

To calculate the estimate for the appropriate rank, we will describe two test statistics, which include the trace statistic and the maximum eigenvalue statistic. The trace statistic specifies the null of hypothesis, H_0, for r cointegration relations as,

$$\lambda_{\text{trace}} = -T\sum_{i=r+1}^{n} \log\left(1-\hat{\lambda}_i\right), \text{ r} = 0, 1, 2,\ldots, \text{n}-1, \qquad (4.6)$$

where the alternative hypothesis is that there are more than cointegration relationships. The maximum eigenvalue statistic for the null hypothesis of at most cointegration relationships is then computed as,

$$\lambda_{\max} = -T\sum_{i=r+1}^{n} \log\left(1-\hat{\lambda}_{r+1}\right), \text{ r} = 0, 1, 2,\ldots, \text{n}-1 \qquad (4.7)$$

where the alternative hypothesis is that there are r+1 co-integration relationships.

For both tests, the asymptotic distribution is non-standard and depends upon the deterministic components (constant and trend), just as in the case of the univariate Dickey-Fuller test for unit roots. Tabulated critical values can be found in Johansen (1988) and Osterwald-Lenum (1992). In both cases, the calculated test statistics must be greater than tables to reject the null hypothesis.

Error Correction Model (ECM)

Where a co-integrating relationship may be used to define an equilibrium relationship, the time paths of co-integrated variables are influenced by the extent of any deviation from the long-run equilibrium. If the variables are cointegrated, then they will return towards the equilibrium values, although they need not actually attain these values at a particular point in time. What is essential is that there is a force that will draw the variables towards the equilibrium values, so that the deviation from equilibrium is not permanent.

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The deviation of a co-integrated variable from the path of equilibrium may be modelled with the aid of an error correction representation. Engle and Granger (1987) formalised the connection between this dynamic response to the errors and co-integration in the Engle-Granger representation theorem, which states that two variables are cointegrated if, and only if, there exists an error correction mechanism for one set of variables.

Consider X_1 and X_2 as share prices that are co-integrated. If it is assumed that the gap between the prices during the current period of time is relatively large when compared to the long-run equilibrium values. In this case, the low priced share X_2 must rise relative to the high priced share X_1. This can be accomplished by either an increase in X_2 or a decrease in X_1, an increase in X_1 with a larger decrease in X_2, or a decrease in X_1 with a smaller decrease in X_2.

The regression that describes the relative movements in the two prices could then take the form:

$$P_{1,t} = \beta_1 P_{2,t} + \mu_t \qquad (4.8)$$

If the errors, μ_t, are stationary then they may be described by the autoregression:

$$\mu_t = \phi\mu_{t-1} + \varepsilon_t \quad with\,|\phi_1| < 1 \qquad (4.9)$$

Hence after writing equation (4.9) as $\mu_t = P_{1,t} - \beta_1 P_{2,t,}$ and substituting it in equation (5.0), we have

$$P_{1,t} - \beta_1 P_{2,t} = \phi_1(P_{1,t-1} - \beta_1 P_{2,t-1}) + \varepsilon_t$$
$$P_{1,t} = \beta_1 P_{2,t} + \phi_1(P_{1,t-1} - \beta_1 P_{2,t-1}) + \varepsilon_t \qquad (5.1)$$

Adding and subtracting $P_{1,t-1}\ and\ P_{2,t-1}$ on both sides, we have

$$\Delta P_{1,t} = -(1-\phi_1)(P_{1,t-1} - \beta_1 P_{2,t-1}) + (\beta_1 \Delta P_{2,t-1}) + \varepsilon_{1,t}$$
$$= \alpha(P_{1,t-1} - \beta_1 P_{2,t-1}) + \varepsilon_{1,t} \qquad (5.2)$$

where $\alpha = -(1-\phi_1),$ while $\beta_1 \Delta P_{2,t}$ is stationary and $\varepsilon_{1,t} = (\beta_1 \Delta P_{2,t} + \varepsilon_{1,t}).$

Thus large persistence in the autoregressive error would imply a slow speed of adjustment. This is an error correction mechanism (ECM), which describes the manner in which the variables return to equilibriums. Assuming the two share prices are CI (1,1), then their respective error mechanism is written as

$$\Delta P_1 = \alpha_1(P_{2,t-1} - \beta_1 P_{1,t-1}) + \varepsilon_{1.t}$$
$$\Delta P_2 = \alpha_2(P_{2,t-1} - \beta_1 P_{1,t-1}) + \varepsilon_{2.t} \qquad (5.3)$$

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RESULTS AND FINDINGS

Table 4.1: Results of ADF Unit root test of Stationarity

Variables	ADF test statistic @ Levels	ADF test statistic @ First Difference	Remark
LNPSG	1.818943	-5.685654	I (1)
LNRGDP	-0.188491	-5.095387	I (1)
LNPCI	-1.103583	-3.983405	I (1)
LNINTR	-2.368060	-5.417515	I (1)
LNEXR	2.253783	-4.050592	I (1)
LNINFR	-1.489542	-4.006965	I (1)
LNBMS	-0.841495	3.067400	I (1)
5% Critical value:	-2.938987	-2.941145	

The unit root tests at significance level and at first difference are summarized in table 4.1 above. It can be seen that Private Sector Growth (PSG), Real Gross Domestic Product (RGDP), Per Capita Income (PCI), Interest Rate (INTR), Exchange Rate (EXR), Inflation Rate (INFR), and Broad Money Supply (BMS) are all stationary at the first difference and are therefore integrated of order I(1). Since none of the variables is integrated of order I(0), and since the order of integration of the variables is not of mixed order [i.e. not I(1) and I(0)], we test for the existence of a long-run relationship amongst the variables using the Johansen cointegration test.

Table 4.2: Results of Johansen Cointegration Test

Unrestricted Cointegration Rank Test (Trace)				
Hypothesised No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None *	0.813845	178.0745	125.6154	0.0000
At most 1 *	0.683512	114.1899	95.75366	0.0015
At most 2 *	0.602622	70.47201	69.81889	0.0443
At most 3	0.379951	35.40302	47.85613	0.4269
At most 4	0.188018	17.24069	29.79707	0.6222
At most 5	0.138211	9.326154	15.49471	0.3361
At most 6	0.092154	3.673843	3.841466	0.0553

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**

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Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesised No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.813845	63.88459	46.23142	0.0003
At most 1 *	0.683512	43.71789	40.07757	0.0186
At most 2 *	0.602622	35.06898	33.87687	0.0359
At most 3	0.379951	18.16233	27.58434	0.4817
At most 4	0.188018	7.914540	21.13162	0.9088
At most 5	0.138211	5.652311	14.26460	0.6581
At most 6	0.092154	3.673843	3.841466	0.0553

Max-eigenvalue 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**

Table 4.2 above shows the cointegration test result. The Trace statistic and the Max-Eigen statistic both indicate 3 co-integrating equations at a 5% level. The existence of 3 co-integrating equations confirms that there is a long-run relationship amongst the variables. Therefore, this leads to the estimation of the model parameters using the Error Correction Model (ECM).

Table 4.3: Error Correction Model Result

Error Correction Model				
Included observations: 37 after adjustments				
Variable	**Coefficient**	**Std. Error**	**t - Statistic**	**Prob.**
C	-156.0153	1039.94	-0.15002	0.000000
D(PSG)	-0.316801	0.26621	-1.19006	0.911080
D(RGDP)	0.809397	0.61247	1.32152	0.094200
D(INTR)	-0.115166	0.29366	-0.39218	0.000000
D (PCI)	0.015536	0.33489	-0.04639	0.097000
D(NFR)	-0.482010	0.16645	-2.89585	0.477400
D(EXR)	-0.071886	0.24785	-0.29004	0.000000
D(BMS)	0.916628	0.41348	2.21688	0.044000
ECM (-1)	-0.455574	0.18007	-2.52994	0.000000
R-squared	0.397159	Mean dependent var		869.0672
Adjusted R-squared	-0.033442	S.D. dependent var		3905.802
F-statistic	0.922336	Akaike info criterion		19.70968
Log-likelihood	-348.6290	Schwarz criterion		20.40629

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A cursory examination of the Error Correction Model estimates above shows that the short-run coefficients of Real Gross Domestic Product (RGDP), Per Capita Income (PCI), Broad Money Supply (BMS) are positive while Private Sector Growth (PSG), Interest Rate (INTR), Inflation Rate (INFR), Exchange Rate (EXR), are negative.

The determinants of the private sector growth in Nigeria of Private Sector Growth (PSG) means that for every unit increase in private sector growth in Nigeria on Private Sector Growth decreases by 0.316801units annually. This implies a direct relationship between determinants of the private sector growth in Nigeria and private sector growth for the period reviewed. However, this direct relationship was found to be insignificant.

The positive and significant coefficient of the determinants of the private sector growth in Nigeria of Real Gross Domestic Product (RGDP) means that for every unit increase in determinants of the private sector growth in Nigeria in Real Gross Domestic Product increases significantly by 0.809397 units annually. This shows that determinants of the private sector growth in Nigeria in Real Gross Domestic Product have not helped significantly to grow the economy in Nigeria.

Again, the coefficient of Exchange Rate shows that a unit decrease in the determinants of the private sector growth in Nigeria in Exchange Rate (EXR) decreases the private sector growth in Nigeria by 0.071886 units. This shows a direct relationship between determinants of private sector growth in Nigeria and the Exchange Rate in Nigeria. Moreover, this direct relationship was found to be significant in growing the economy in Nigeria.

Also, the positive and significant coefficient of the determinants of the private sector growth in Nigeria in Broad Money Supply (BMS) means that for every unit increase in the determinants of the private sector growth in Nigeria in Broad Money Supply in Nigeria increases significantly by 0.916628 units annually. This shows that determinants of the private sector growth in Nigeria in Broad Money Supply have helped significantly to grow the economy in Nigeria.

More so, the determinants of the private sector growth in Nigeria in Interest Rate (INTR) show a negative relationship with private sector growth in Nigeria decreasing it by 0.115166 units. Based on the result obtained, it means that the determination in Nigeria has done enough based on the private sector growth in Nigeria. However, it was found to be significant.

Moreover, the determinants of the private sector growth in Nigeria in Per Capita Income (PCI) show a positive relationship with private sector growth in Nigeria. Which increases by 0.015536 units. This shows that determination in Nigeria has not helped significantly to grow the private sector growth in Nigeria.

Furthermore, the determinants of the private sector growth in Nigeria in Inflation Rate (INFR) show a negative relationship with private sector growth in Nigeria decreasing it by 0.482010 units. Based on the result obtained, it means that the determination in Nigeria has not done enough based on the private sector growth in Nigeria.

The joint test of hypothesis revealed that the determinants of the private sector growth in Nigeria have a significant effect on the Nigerian economy of the private sector growth in Nigeria.

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The result shows that the ECM (-1) is negative and significant. The Error Correction coefficient of 0.455574 is the speed of adjustment of the model from the short-run equilibrium to the long-run equilibrium. This implies that 45% of the error is corrected in each time period. The speed of adjustment implies that it will take some years to correct all errors/deviations and bring the economy of Nigeria back to equilibrium.

The adjusted coefficient of determination of 0.397159 implies that about 39% of the economy in Nigeria is accounted for by determinants of the private sector growth in Nigeria. This represents a good fit.

Table 4.4: Granger-causality test Results

Null Hypothesis:	Obs	F-Statistic	Prob.
RGDP does not Granger Cause PSG	38	5.81608	0.0069
PSG does not Granger Cause RGDP		0.54185	0.5868
PCI does not Granger Cause PSG	38	2.11165	0.1371
PSG does not Granger Cause PCI		0.27097	0.7643
INTR does not Granger Cause PSG	38	0.61876	0.5447
PSG does not Granger Cause INTR		1.38394	0.2648
EXR does not Granger Cause PSG	38	3.74730	0.0342
PSG does not Granger Cause EXR		1.04368	0.3635
INF does not Granger Cause PSG	38	0.10494	0.9007
PSG does not Granger Cause INF		1.60996	0.2152
BMS does not Granger Cause PSG	38	3.44791	0.0437
PSG does not Granger Cause BMS		13.2719	6.E-05
PCI does not Granger Cause RGDP	38	11.3693	0.0002
RGDP does not Granger Cause PCI		0.08454	0.9191
INTR does not Granger Cause RGDP	38	0.57889	0.5661
RGDP does not Granger Cause INTR		1.91378	0.1635
EXR does not Granger Cause RGDP	38	2.38101	0.1082
RGDP does not Granger Cause EXR		4.51456	0.0185
INF does not Granger Cause RGDP	38	0.11633	0.8905
RGDP does not Granger Cause INF		3.78118	0.0332
BMS does not Granger Cause RGDP	38	1.13140	0.3348
RGDP does not Granger Cause BMS		12.7238	8.E-05

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INTR does not Granger Cause PCI PCI does not Granger Cause INTR	38	0.83140 0.90879	0.4444 0.4129
EXR does not Granger Cause PCI PCI does not Granger Cause EXR	38	1.00422 2.84266	0.3772 0.0726
INF does not Granger Cause PCI PCI does not Granger Cause INF	38	0.35590 1.36079	0.7032 0.2705
BMS does not Granger Cause PCI PCI does not Granger Cause BMS	38	0.26403 0.84261	0.7696 0.4396
EXR does not Granger Cause INTR INTR does not Granger Cause EXR	38	0.97715 0.34334	0.3870 0.7119
INF does not Granger Cause INTR INTR does not Granger Cause INF	38	0.03689 0.74531	0.9638 0.4824
BMS does not Granger Cause INTR INTR does not Granger Cause BMS	38	0.51947 0.37339	0.5996 0.6913
INF does not Granger Cause EXR EXR does not Granger Cause INF	38	0.16373 0.52523	0.8497 0.5963
BMS does not Granger Cause EXR EXR does not Granger Cause BMS	38	4.80851 6.25799	0.0147 0.0050
BMS does not Granger Cause INF INF does not Granger Cause BMS	38	1.01012 0.61265	0.3752 0.5480

Table 4.4 contains the results of Granger Causality tests. The essence of this test is to establish a causal relationship among Real Gross Domestic Product (RGDP), Per Capita Income (PCI), Interest Rate (INTR), Exchange Rate (EXR), Inflation Rate (INFR), and Broad Money Supply (BMS) and the growth of Nigerian economy. This test gives us the direction of causality among these variables. There are usually two outcomes of this test, unidirectional or bidirectional relationship. In this study, it was observed that there was a bidirectional relationship among the variables as well unidirectional relationship existed, that is, real GDP causes PSG, EXR causes PSG, Broad Money Supply causes PSG, Private Sector Growth causes BMS, PCI causes RGDP, RGDP causes EXR, RGDP causes INF, RGDP causes BMS, BMS causes EXR, EXR causes BMS.

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CONCLUSION

The study concludes based on the empirical findings that the determinants of the private sector growth in Nigeria contributed to the improvement and enhancement of Interest Rate, Exchange Rate and Broad money Supply in Nigeria. Even though Private Sector Growth, Real Gross Domestic Product, Per Capita Income, Inflation Rate have contributed positively to the development of private sector growth in Nigeria, it has not significantly affected the generality of the people in terms of economic growth and development based on private sector growth in Nigeria.

Policy Recommendations

In the light of the empirical findings, the study recommends as follows:

(A). The study finds a significant negative relationship between interest rate and exchange rate; it shows that continued attraction of real sector development from private investors would boost economic growth in Nigeria. It is recommended that one way to develop human capital for Nigeria would be to put in place policies and infrastructures that could encourage private investment inflows.

(B). However, the study finds a significant positive and negative relationship between interest rate, exchange rate and broad money supply. As a result, these financial institutions have muscular apprehension on these private sector investors by boosting credit and availability of foreign exchange for those investors that require imported raw materials.

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NEXUS BETWEEN EXCHANGE RATE FLUCTUATION AND FOREIGN DIRECT INVESTMENT IN NIGERIA

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ABSTRACT: *This study examined the nexus between exchange rate fluctuation and foreign direct investment in Nigeria from 1986 to 2020. The research was conducted using relevant econometric tools which include unit root test, co-integration test and Autoregressive Distributed Lag (ARDL) model. The results of ADF unit root test revealed that only interest rate is stationary at level while exchange rate, foreign direct investment, gross capital formation and inflation rate became stationary at first deference. The bounds test showed that there is a long run relationship between the foreign direct investment inflows, interest rate, exchange rate, gross capital formation and trade openness in Nigeria. The findings revealed a negative relationship between exchange rate and foreign direct investment in Nigeria and all the lagged value of exchange rate are statistical significant at 5% level of significant, which an indication of exchange rate importance on foreign direct investment inflows into Nigeria to a two standard error shock of exchange rate showed that exchange rate effect on foreign direct investment is persistence and significantly positive over the a period of up to 8 years after the shock. The exchange rate, though relatively stable, has a profound effect on foreign direct investment in Nigeria. The study recommended that given the perceived over-valued naira, a deliberate effort toward revaluation of the naira to reflect the true value of dollar to naira exchange rate will obviously increase the exchange rate and as such makes it cheaper to invest in Nigeria by foreign businesses.*

KEYWORDS: Exchange Rate, Exchange Rate Fluctuation, Foreign Direct Investment

JEL Classification: F31, E32, F21

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INTRODUCTION

The growing interest in Foreign Direct Investment (FDI) stems from the perceived opportunities derivable from utilizing this form of foreign capital injection into the economy to augment domestic savings and further promote economic growth in most developing economies (Aremu, 2005). FDI is believed to be stable and easier to service than bank credit and is usually on long term economic activities in which repatriation of profit only occurs when the project earns profit. As stated by Dunning (2009), FDI contributes to the receiving country's gross capital formation, higher growth, industrial productivity and competitiveness and other spin-off benefits such as transfer of technology, managerial expertise, improvement in the quality of human resources and increased investment.

According to Tsai (1994), the potential importance of FDI in Less Developed Countries (LDCs) growth process is getting appreciated. The importance is classified into economic, political, social and legal factors. The economic factors include infrastructural facilities, favourable fiscal, monetary, trade and exchange rate policies. The degree of openness of the domestic economy, tariff policy, and credit provision by a country's banking system, indigenization policy, the economy's growth potentials, market size and macroeconomic stability. Other factors like higher profit from investment, low labour and production cost, political stability, enduring investment climate, functional infrastructure facilities and favourable regulatory environment also help to attract and retain FDI in the host country (Ekpo 1995).

From a traditional standpoint, exchange rate did not constitute an important dimension in the analysis of economic growth, such that the first generation of neo-classical economists did not consider exchange rate in the growth models or in their practical policy incarnations that focused on savings and investment as determinants of growth. This indicates that these were closed-economy models that dictated that exchange rate, defined as the ratio of relative prices of non-traded goods (all goods being non-traded in closed economies) had no role in the growth process. However, there is a lot of evidence that many countries maintain a disequilibrium real exchange rate that is overpriced or under-priced as compared to the equilibrium level. Resource rich countries like Nigeria often maintain an overpriced exchange rate that is imposing constraints on their economic growth. On the contrary, many developing countries (including those rich in resources) pursue the conscious policy of low exchange rate as part of their general export orientation strategy. The argument against a policy of low exchange rate is that it leads to monetary expansion and hence to inflation. Calvo and Reinhart (1995) argued that the under-valuation of the exchange rate is inflationary in theory and was inflationary in practice for Latin American countries in the 1980s. It appears, however, that the effect depends on the instrument used to support low exchange rate with implications.

Rodrik (1986) developed models demonstrating how disequilibrium exchange rates in the presence of foreign trade externalities could lead to the acceleration of growth. However, these studies did not consider the problem of inflation in detail. Calvo and Reinhart (2000) argued that these fluctuations are much more harmful for developing countries than for developed economies so that a fixed exchange rate regime is preferable for developing economies. Walsh and Yu (2010) also observed a long-standing impression among policymakers that FDI is more conducive for long-run growth and development than other forms of capital inflows. Arguments for this hypothesis have been diverse, but most often based on the idea that FDI brings with it foreign technology and management skills, which can then be adapted by the

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host country in other contexts. This impression is strengthened by the fact that rapidly growing economies tend to absorb more FDI, though with FDI both contributing directly to growth and with foreign companies naturally eager to invest in rapidly growing economies, the direction of the causality is not clear in Nigeria.

The literature on FDI and growth is not fully conclusive in Nigeria, even though FDI flows into the country have been high especially in the last two decades. It remains an open question, however, as to what pulls FDI into emerging economies like Nigeria. It is intuitive that FDI should flow into countries with relatively stable exchange rate and economic conditions and strong institutions, and that investors should be concerned about political instability, inflexible regulations, and poor development indicators. But there is strangely little evidence to support these arguments in Nigeria.

However, despite the increased foreign capital inflows to Nigeria, instability in the exchange rate has posed serious challenges to foreign direct investment and economic growth. Foreign investors come into the domestic economy with expectations of positive returns; despite the various types of risks that they are exposed to. The risks include the exchange rate, inflation rate, interest rate, political, and legal risks. The reinvestment of earnings in the domestic economy depends on the level of these risks, the size of returns and future expectations. Expectations of investors play an important role to determine the level of investment and in boosting economic activities of a country (Osinubi & Amaghionyeodiwe, 2009). If foreign investors are optimistic about the future, they will invest their funds.

There is, however, a debate on the impact of exchange rate fluctuations on foreign capital inflows in many countries like Nigeria. This has led to uncertainties in the domestic economies which lead to the expectation that exchange rate instability in the domestic economy reduces earnings on foreign investments and thus discourages capital inflows (Adegoriola & Agunbiade, 2019). It is, however, difficult to reconcile the adverse effects of exchange rate fluctuations with the continued large inflows into Nigeria. The relationship between FDI and exchange rate in Nigeria is yet unclear, and that recent evidence shows that the relationship may be country and period specific. Omankhanlen (2011) revealed that only a limited number of multinationals or their subsidiaries have contributed to FDI in Nigeria. It was observed that aggregate investment expenditure as a share of GDP grew from 16.9% in 1970 to a peak of 29.7% in 1976 before declining to an all-time low of 7.7% in 1985. Thereafter, the highest was 11.8% of GDP in 1990, before declining to 9.3% in 1994. Beginning from 1995, investment/GDP ratio declined significantly to 5.8% and increased marginally to 7.0% in 1997 and remained there until about till 2004 when 7.1% and a continuous decrease in 2006 to 6.6% to an all time low of 4.3% in 2021 was recorded. On the average, about four-fifth of Nigeria's national output was consumed annually.

The sub-optimal investment ratio in Nigeria could be traced to many factors including exchange rate instability, persistent inflationary pressure, low level of domestic savings, inadequate physical and social infrastructure, fiscal and monetary policy slippages, low level of indigenous technology as well as political instability. A major factor was exchange rate instability, especially after the discontinuation of the exchange rate control policy. The high lending rate, low and unstable exchange rate of the domestic currency and the high rate of inflation made returns on investment to be negative in some cases and discouraged investment, especially when financed with loans.

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This high exchange rate volatility in Nigeria, among others, led to a precarious operating environment which can be attributed to the reason why Nigeria was not only unable to attract foreign investment to its fullest potentials but also had a limited domestic investment. As such, despite the vast investment opportunities in agriculture, industry, oil and gas, commerce and infrastructure, very little foreign investment capital was attracted relative to other developing countries and regions competing for global investment capital. As a result of the above, it becomes relevant to investigate the nexus between exchange rate fluctuation and foreign direct investment in the Nigerian economy.

REVIEW OF RELATED LITERATURE

Conceptual Clarification

Exchange Rate Fluctuation

Exchange rate fluctuation is defined as a variation of the prices of one currency in terms of another. It is also called volatility. By depreciating or appreciating the value of a foreign currency, profitability of foreign exchange trades will be affected. Fluctuation in this case takes into account all the movement and changes that are influential for a depreciation/appreciation of a currency. Among many fundamental studies Haile and Pugh (2013) contributed greatly in terms of the effect that exchange rate fluctuation has on the macro-economy. As a result of the abandonment of the fixed exchange rate regime, international investment flows of capital became much higher (as well as international trade and other foreign exchange transactions),but despite the growth markets were still not secured with regards to the risk foreign investors may take to put their money abroad (Chowdhury & Wheeler, 2008). As fluctuation is referred to as an unpredictable and unobservable pattern, foreign investors became more aware and tried to get more information in order to hedge against exchange rate fluctuation risk.

Foreign Direct Investment

According to the World Bank, FDI is defined as the net inflows of investment to acquire a lasting management interest in an enterprise operating in an economy other than that of the investor. It is the sum of equity capital, reinvestment of earnings, other long-term capital, and short-term capital as shown in the balance of payments. An even more complete definition of FDI is given by International Monetary Fund (IMF) and Organization for Economic Co-operation and Development (OECD), which states that direct investor may be an individual, an incorporated or unincorporated private or public enterprise, a government, a group of related individuals, or a group of related incorporated and/or unincorporated enterprises which have a direct investment enterprise, operating in a country other than the country of residence of the direct investor.

For Caves (1974) FDI brings to the host countries many positive effects to their economies such as technology transfer, managerial skills, know-how, international production networks among others. However, FDI goes way beyond promoting growth, technology and education into a country. It has many different types of utility that can serve a country: develop a country's infrastructure, rebalance its national budget surplus, mature human capital, finance capital

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accumulation that could ease imbalances, and even serve as a cushion against any sort of short and long term shocks and economic development.

Theoretical Review

Neoclassical Theory of Capital Flows

According to early neoclassical theories, foreign capital flows are influenced by the highest expected return on investment. Cockcroft and Riddell (1991) stressed that future capital flows are directly influenced by incentives such as expected rate of return; security of investment, tax regimes, investment code or guidelines, and the macroeconomic stability especially with regards to exchange rate and inflation. The neoclassical theory explains that at a particular time how much capital stock a firm desires to achieve. Further, according to this theory, rate of investment is determined by the speed with which firms adjust their capital stocks towards the desired level.

Because it takes time to build and install new machines, construct new factories, warehouses etc., the firms cannot immediately achieve the desired level of capital stock. Therefore, the firms have to decide with what rate or speed per period it makes adjustment in their stock of capital to attain the desired level of capital stock. Firms use capital along with labour to produce goods and services for sale in the market. In deciding about the amounts of labour and capital to be used for production the firms are-guided by not only the prices of these factors but also the contributions they make to the production and revenue of the firms. This is because volatility in macroeconomic variables creates uncertainty for private investment in terms of both the profitability and the cost of investment. Cockcroft and Riddell (1991) recommend that addressing problems that pose a danger to foreign capital inflows would help improve the foreign investment climate. Meier (1995) argued in that line. Developed countries will tend to invest in less developed economies that have growth potential with higher rate of return and a stable macroeconomic base.

Standard Option Theory of Capital Flows

If there are fixed costs in the acquisition of a firm, firms tend to delay their investments (for example in acquisition processes) when they are facing higher exchange rate volatility. Depending on how the home currency equivalent of expected future cash flows from the target firm is correlated with other assets in the acquiring firm's portfolio, high exchange rate volatility may have a positive or negative effect on the investment decision (di Giovanni, 2005).

Given the assumptions of unrestricted, frictionless markets, and continuous trading/stock prices, Black and Scholes were able to demonstrate that synthetic options can be created from portfolios containing the underlying stock and risk free debt. The primary attraction of the Black & Scholes model is that the required input data are relatively easy to obtain. Neither expected rates of return nor are assumptions about individual investor risk preferences required. Those inputs that are required are either directly observable or can be estimated from historical data.

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Trade Theory of Capital Flows

FDI may be higher in countries experiencing uncertainty regarding the exchange rate because such uncertainty acts as a barrier to trade. Multinationals engage in FDI to avoid uncertainty affecting the price of their traded goods as the exchange rate fluctuates. Thus, multinationals increase their FDI to substitute for lower trade volumes in markets associated with higher volatility (Goldberg & Kolstad, 1995). Also, cross-border investment may be a substitute for trade when tariffs or other barriers prevent the free flow of goods (Russ, 2007). If a country's asset is seen as a claim to a future stream of its currency denominated profits, and if profits will be converted back into the domestic currency of the investor at the same exchange rate, the level of exchange rate does not affect the present discounted value of the investment (Blonigen, 1997).

International trade theories are simply different theories to explain international trade. Trade is the concept of exchanging goods and services between two people or entities. International trade is then the concept of this exchange between people or entities in two different countries. People or entities trade because they believe that they benefit from the exchange. They may need or want the goods or services. While at the surface, this may sound very simple, there is a great deal of theory, policy, and business strategy that constitutes international trade.

Imperfect Capital Market Theory of Capital Flows

Changes in relative wealth affect the bids these firms make, when the purchase of an asset requires funds that are generated within the firm. Thus, depreciation in the host country, by making the relative wealth of foreign investors increasing (outbidding domestic investors) and lowering the investment cost of capital (that is launched in the domestic currency), encourages FDI into that country (Itagaki, 1981; Cushman, 1985; Klein & Rosengren, 1994; Kiyota & Urata, 2004).

Capital market imperfections are limitations that reduce the range of financial contracts that can be signed or honored. These restrictions are more common in capital markets. There are three basic reasons for that: First, lenders do not have full information about the borrower, whether they have the capacity to pay back their debt and/or whether they are willing to pay asymmetric information. Secondly, the lender needs to trust the borrower to commit and to pay back his/her debt or there needs to be a third party to enforce the contract as it is more difficult to enforce contracts ex post (limited commitment).

Finally, since the exchange does not happen at the same time, there is always room for renegotiation. In a perfect capital market case, assuming complete markets, perfect rationality of agents and under full information, the equilibrium occurs where the interest rates clear the market, with the supply of funds equal to the demand. Moreover, we can analyze the firm's investment decision and its owner's consumption/saving decision separately. In addition to that, even in case of bankruptcy risk, the resulting optimum choice of firm will be efficient as the interest rate increases to capture the bankruptcy risk. Therefore, the possibility of default of the borrower is not a main driving force that leads to imperfect capital markets.

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Real Options Theory of Capital Flows

This is the flexibility of the option value that a firm has in delaying an investment decision in order to obtain more information about the future. For a firm to raise profits from FDI activities, it must take into account the different types of FDI and its timing. Therefore, the impact that the exchange rate uncertainty might have on a firm's decision to invest, is ambiguous. In the case of a risk averse firm, whenever the exchange rate uncertainty becomes higher, a market-seeking firm tends to delay its decision to invest, however if it is an export-substituting firm, the decision is to increase its FDI activity (Dixit & Pindyck, 1994).

Real option theory draws parallel between the valuation of the financial options available and the real economy. The theory has become a popular theme in most business schools in the world as well as choices available to a company regarding an investment opportunity. The term real means that it refers to a tangible asset and not a financial instrument. Examples of real options include determining whether to build a new factory, change the machinery and technology on a production line, decide whether to buy a potential lucrative oil field and when to start drilling or pumping. They do not include derivative financial instruments such as stocks or bonds. However, the trade theory will be adopted at the cost of this research since it is more related to the topic in review.

Empirical Review

Adofu and Adegoriola (2020) studied the relationship between foreign portfolio investment and Nigerian economic growth from 1986 to 2018. The Autoregressive Distributed Lag model was used as a methodology to analyze the data. Findings from the study, results showed that current value and one period lag of foreign portfolio investment showed negative and insignificant impacts on the economic growth. The study concluded that the level of fluctuation of foreign portfolio investment into Nigeria at the moment signifies that the economy needs total reform in order to gain the confidence of the foreign investors. The study therefore, recommends that the government should double its effort at improving the investment. The government should support the prevailing investors through improvement in infrastructural development; provision of services and changes within the regulatory framework by relaxing laws on profit repatriation among others.

Barguellil, Ben-Salha and Zmami (2018) examined the impact of exchange rate volatility on economic growth. An empirical investigation based on a sample of 45 developing and emerging countries over the period of 1985-2015 is conducted using the difference and system generalized method of moment's estimators. Findings suggest that the generalized autoregressive conditional heteroskedasticity-based measure of nominal and real exchange rate volatility has a negative impact on economic growth. Also, the effect of exchange rate volatility depends on the exchange rate regimes and financial openness, that is, volatility is more harmful when countries adopt flexible exchange rate regimes and financial openness.

Efiong, Ayuk and Imong (2018) investigated the effects of exchange rate fluctuations on foreign direct investment in Nigeria between 2001-2015. The study adopted a quasi-experimental research design considering the fact that time series data were analyzed. The study adopts the Vector Auto regression Wald Test and the Granger Causality test to analyse the obtained data. The study reveals a unidirectional causality run from exchange rate

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fluctuation to foreign direct investment inflow into Nigeria, and no causality run between Inflation Rate and Foreign Direct Investment.

In their study on exchange rate fluctuations and foreign private investments in Nigeria, Mbanasor and Obioma (2017) used two-stage least squares (2LS) to analyse the data. The result showed the exchange rate fluctuation has a negative and non-significant impact on Nigeria's foreign private investment. This indicates that a one percent increase in foreign private investment into Nigeria may be due to 0.015 percent decrease in exchange rate fluctuations. The result of this study that exchange rate fluctuations has negative and non-significant impact on Nigeria's foreign private investment supports the above argument implying that FDI investment in Nigeria is not determine by exchange rate but on other motives such as technology, entrepreneurial skills, source of capital an overall motive to make profit irrespective of the exchange rate. In the same vein, Iyke and Sin-Yu (2017) examined exchange rate uncertainty and domestic investment in Ghana using ARDL bounds testing approach covering the period 1980–2015. The study reveals that exchange rate uncertainty has differential impacts on domestic investment in the short run. That is, while the current level of uncertainty enhances investment, previous levels of uncertainty dampen investment. In the long run, exchange rate uncertainty has a positive impact on domestic investment.

Murtala (2017) examined the impact of exchange rate fluctuations on foreign direct investment in Nigeria over the years to be precise 26 years coverage (1990-2015). The data obtained were analyzed using regression and correlation analysis techniques. Findings from the analysis show that there is a strong positive relationship between FDI and exchange rate in Nigeria on one hand and there is a weak positive relationship between FDI and GDP on the other hand. The researcher also found that there was a significant inflow of FDI from 2005-2014 due to a rise in the exchange rate in the same period. The study concludes that exchange rate, FDI, and GDP are positively correlated.

In their study on exchange rate and foreign direct investment (FDI) in Nigeria, Alobari, Paago, Igbara and Emmah (2016) used descriptive analysis as methodology for secondary data on exchange rate and FDI. The findings of the study agrees with some other research reports that Nigeria has so far attracted little of FDI and has lost much of the few it has attracted, yet there are good developmental resources to be desired which come with FDI. The study also found a relationship between FDI, Exchange rate and Economic Growth in Nigeria. Also, Jongbo (2014) studied the impact of real exchange rate fluctuation on industrial output in Nigeria which employed Ordinary Least Square (OLS) in analysing the obtained data. The results show that real exchange rate play a significant role in determining the industrial output and also in addition, availability of foreign exchange increase through contentious export drive from both oil and non-oil products will contribute tremendously to increase industrial output. The study further reveals that the capacity utilization ratio is low the cases of which may not be too far away from, partly epileptic power supply, lack of adequate and appropriate technology and so on and also that the impact in bidirectional (real exchange rate in industrial output.

Wang (2013) looks at the impact of exchange rate volatility on foreign direct investment (FDI) in BRIC countries. Specifically, Brazil, Russia, India, and China (BRIC). The sample of data was selected over the period of 1994-2012 for both exchange rate volatility and foreign direct investment for all countries. The standard deviation of monthly exchange rate changes is applied to examine the exchange rate volatility and its influence upon foreign direct investment using an Autoregressive Distributed Lag (ARDL) approach and the co-integration and Error

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Correction Model. The results indicate a negative long-run relationship between exchange rate volatility and foreign direct investment for India and Russia. The existence of a short-run association was found in China, India, and Russia. However, for Brazil no connection between the two variables was observed.

Ullah, Haider and Azim (2012) investigated the relationship of foreign direct investment with exchange rate and exchange rate volatility in Pakistan. Time series data over a 30 years period between 1980 and 2010 was collected. The variables of interest included exchange rate and its movements, inflation, FDI and trade openness. Unit root test, causality analysis, volatility and co-integration technique were used to analyze the data. According to the findings FDI had a positive relationship with Rupee depreciation, exchange rate volatility deterred FDI and trade openness considerably attracted FDI while inflation was found to be insignificant to the study. The outcomes of Granger causality test proposed that exchange rate volatility granger caused foreign direct investment and not the other way round.

Ogun, Egwaikhide and Ogunleye (2012) studied the real exchange rate and foreign direct investment in Sub-saharan Africa. The study employed the Granger causality and simultaneous estimation techniques. The use of simultaneous equations is informed by the theoretical and empirical inconclusiveness on the relationship between movements in real exchange rate (RER) and foreign direct investment (FDI). The Granger Causality test further provides insight on the causal direction of the variables. Whereas the causality tests suggest statistical dependence between RER movements and FDI for a few of the countries, the regression analyses show a statistically significant relationship between these variables. While the inclusion of the pre-reform period in the study may have contributed to these results, the general picture emerging is that FDI flows are sensitive to RER movements in SSA.

THEORETICAL FRAMEWORK AND METHODOLOGY

Theoretical Framework

A string of literature exists on the forces that affect exchange rate. However, the empirical results are mixed and still seem to be in the data. Some studies have analyzed exchange rate in a neoclassical framework whereas others have used a Standard Option Theory approach for its modeling. Dornbusch (1987) theoretically explained the relationship between foreign direct investment, exchange rate and prices for an open economy by applying various approaches including Standard Option Theory model based on the law of one price, neoclassical model based on the assumption that each country is fully specialized in its home production, Counot Model based on oligopolistic market and the Dixit-Stiglitz Model based on a utility maximization function of consumers.

This study adopts the real options theory as the theoretical framework for the model as it best explains the intent of this work. The theory emphasizes the valuation of the financial options available in the real economy in line with the Nigeria exchange rate policy of flexible regime. The theory believes in determining whether to build a new factory, change the machinery and technology on a production line, decide whether to buy a potential lucrative oil field and when to start drilling or pumping, making decisions before embarking in investment. The theory proves to be better and fit to Nigeria given the potential impact of exchange rate on prices, investment, balance of payments, and interest rate, the issue of the determination of ideal

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exchange rate between countries becomes imperative for the successful implementation of development programs (Dare & Adekunle, 2020). They argued that the objectives of exchange rate policy are to increase output and stability in domestic prices. A necessary condition for the achievement of the above objectives is that the exchange rate should be as stable as possible. According to him, stability permits viability of the rate in response to changes in relative prices; international terms of trade and development factors.

Model Specification

This study is based on the assumption that the inflow of foreign direct investment (FDI) affects economic growth in Nigeria (GDP), exchange rate (EXR) and other macroeconomic variables like interest rate (INR) and inflation rate (INF) in- turn affect the inflow of Foreign Direct Investment (FDI). Hence, the model:

GDP = f(FDI) 1

FDI = f(EXR, INR) 2

Considering the fact that FDI of an economy is not determined by EXR, INR, INF alone, the inclusion of two more important FDI inflow variables; and Trade Openness (TOP), Gross Capital Formation (GCF), is made so as to get a more realistic model: Hence, equations (1) and (2) is extended thus:

FDI = f(EXR, INR, TOP, GCF) 3

Thus, the statistical form of the model is:

FDI = ßo + ß$_1$ EXR + ß$_2$ INR + ß$_3$ TOP + ß$_4$ GCF + e 4

Where:

ß$_0$, ß$_I$, ß$_2$, ß$_3$ & ß$_4$ are all the parameter estimates while e is the error term.

ß$_I$ & ß$_2$ < 0 while ß$_3$ & ß$_4$ > 0.

Since there is a level of interrelationship between the variables, the ARDL is more suitable as it captures the joint interdependency of the variables against each other. The specification of the Auto Regressive Distributed Lag (ARDL) model is given below:

$$\Delta FDI_t = \alpha^{FDI} + \sum_{I=1}^{K} \beta_i^{FDI} \Delta FDI_{t-i} + \sum_{i=1}^{K} \gamma_i^{FDI} \Delta EXR_{t-i} + \sum_{i=1}^{K} \theta_i^{FDI} \Delta INTR_{t-i} + \sum_{i=1}^{K} \vartheta_i^{FDI} \Delta TOP_{t-i} + \sum_{i=1}^{K} \pi_i^{FDI} \Delta GCF_{t-i} \quad \text{.....5}$$

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RESULTS AND DISCUSSION

Table 1: Descriptive Statistics

	EXR	FDI	GCF	INTR	TOP
Mean	98.87916	378.3875	943.5486	18.70920	0.082019
Median	114.8886	179.9500	435.9086	17.87167	0.018119
Maximum	306.0837	1360.400	4012.919	31.65000	0.468774
Minimum	0.893774	0.400000	8.799480	9.433333	0.000244
Std. Dev.	86.41662	412.7590	1173.334	4.171212	0.114105
Skewness	0.687772	0.889632	1.404838	0.568649	1.613597
Kurtosis	4.902563	3.586293	3.854181	4.881649	5.231634
Jarque-Bera	2.693951	4.727327	12.21720	6.848239	21.80953
Probability	0.260025	0.094075	0.002224	0.032578	0.000018
Sum	3361.892	12865.17	32080.65	636.1127	2.788645
Sum Sq. Dev.	246438.5	5622210.	45431507	574.1673	0.429659
Observations	34	34	34	34	34

Source: Author's Computation, 2021.

The result in table 1 showed that the mean values of all the variables are positive with Gross Capital Formation (GCF) having the highest average value of 943.5486. On the other hand, Foreign Direct Investment (FDI), Exchange Rate (EXR), Interest Rate (INTR) and Trade Openness (TOP) ranked second, third, fourth and fifth respectively. Furthermore, the minimum and maximum values change from positive to positive in all cases for all the variables. The implication of this is that all the variables are increasing over time during the study period. The table also revealed that GCF, FDI and EXR have the highest standard deviations of 1173.3,412.8 and 86.4respectively. This implies that GCF, FDI and EXR are the most volatile variables used in the study. The skewness which measures the asymmetry of the distribution of the series about the mean is positive. However, the skewness of the normal distribution is zero, but the distribution of all the variables used in the study are positively skewed and greater than zero implying that they have a long right tail and therefore are not normally distributed. In terms of kurtosis, all the variables displayed platykurtic characteristics as they have wide spread from the mean. Also, the kurtosis of the variables has values greater than three (3). Jaque-Bera statistics showed that the null hypothesis that all variables are normally distributed is rejected as the normality of all the variables is not statistically significant at 5%. Therefore, all the variables are not normally distributed, that is FDI and EXR while GCF, INT and TOP are normally distributed.

Table 2: ADF Unit Root Test Result

ADF Statistics				
Variables	Level	First difference	Order of Integration	Remark
EXR	-1.392769	-4.037147*	I(1)	Stationary
FDI	- 1.347908	-3.258817**	1(1)	Stationary
GCF	-2.117151	-2.746189*	1(1)	Stationary
INF	-2.128278	-3.300803**	1(1)	Stationary
INTR	-3.082685**	-6.380011*	1(0)	Stationary

Source: Author's Computation 2021.

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The result of the ADF unit root test in table 2 revealed that only interest rate was stationary at level while other variables like Exchange Rate, Foreign Direct Investment, Gross Capital Formation and Inflation Rate were not stationary at level. However, after the first difference they became stationary. This was achieved by comparing the ADF test statistics with their respective critical values at 5 %, this gives the order of integration of purely I(0) and I(1). The order of integration of the variables connote that there may be a long run relationship between and among the variables.

Table 3: ARDL Bounds Test Result

Test Statistic	Value	Signif.	I(0)	I(1)
F-statistic	5.778759	10%	1.92	2.89
K	7	5%	2.17	3.21
		2.5%	2.43	3.51
		1%	2.73	3.9

Source: Author's Computation 2021.

From the result of the bounds test, the F-statistic value falls outside the critical upper bounds, the study draws the conclusion that there is a long run relationship between variables. The long-run and the short estimate to ascertain the relationship between the variables and the adjustment speed within the short run to establish the effect of exchange rate fluctuations on foreign direct investment in Nigeria.

Table 4: ARDL Result

Dependent variable (FDI) / **Independent variables**	**LAG**		
	Current	**1**	**2**
EXR	-14.16** (-1.84)	-26.60** (-1.89)	-13. 98* (-2. 56)
INTR	-74. 71** (-1.93)	-58.42** (-1.78)	-6.60* (-2.07)
GCF	0.47* (3.22)	1. 73** (1.82)	0.65* (2.42)
TOP	0.31* (2. 57)	0.09* (3.03)	0.20** (1. 75)
R^{-2} = 0 99			

Source: Author's Computation 2021.

The result of the ARDL confirmed the prior expectations. This is because it is expected that the sign of the coefficients of exchange rate and interest rate on foreign direct investment in Nigeria to be negative. Therefore, an increase in exchange rate, by ₦1m will bring about ₦14.16, ₦26.60, and ₦13.98 reductions in foreign direct investment in the current period, first,

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and second lags respectively. Also, an increase in interest rate by 1% will bring about 75%, 58%, and 6% reduction in foreign direct investment in the current and previous lags.

On the other hand, an increase in Gross Capital Formation by 1% will bring about 47%, 173% and 61% increase in foreign direct investment in the current and previous lags respectively in Nigeria. Also, 1% increase in Trade Openness will bring about 31%, 9% and 25% increase in foreign direct investment in the country. The R^{-2} of 0.95 implies that the independent variables have explained about 95% of the variation in foreign direct investment in Nigeria. The remaining 5% is attributed to other factors that do affect foreign direct investment other than the variables included in the model. This is captured in the study by the error term. The Durbin – Watson statistics is 1.5 indicating the absence of serial correlation. On the major determinants of foreign direct investment, the results of the ARDL in table 3 shows that exchange rate and interest rate are the major determinants of foreign direct investment inflow into the country. This is so as their coefficients (14.16, 26.60 and 13.98) for exchange rate and (74.71, 58.46 and 6.60) for interest rate for the current, first and second lags respectively appeared to have the highest effect on foreign direct investment in Nigeria.

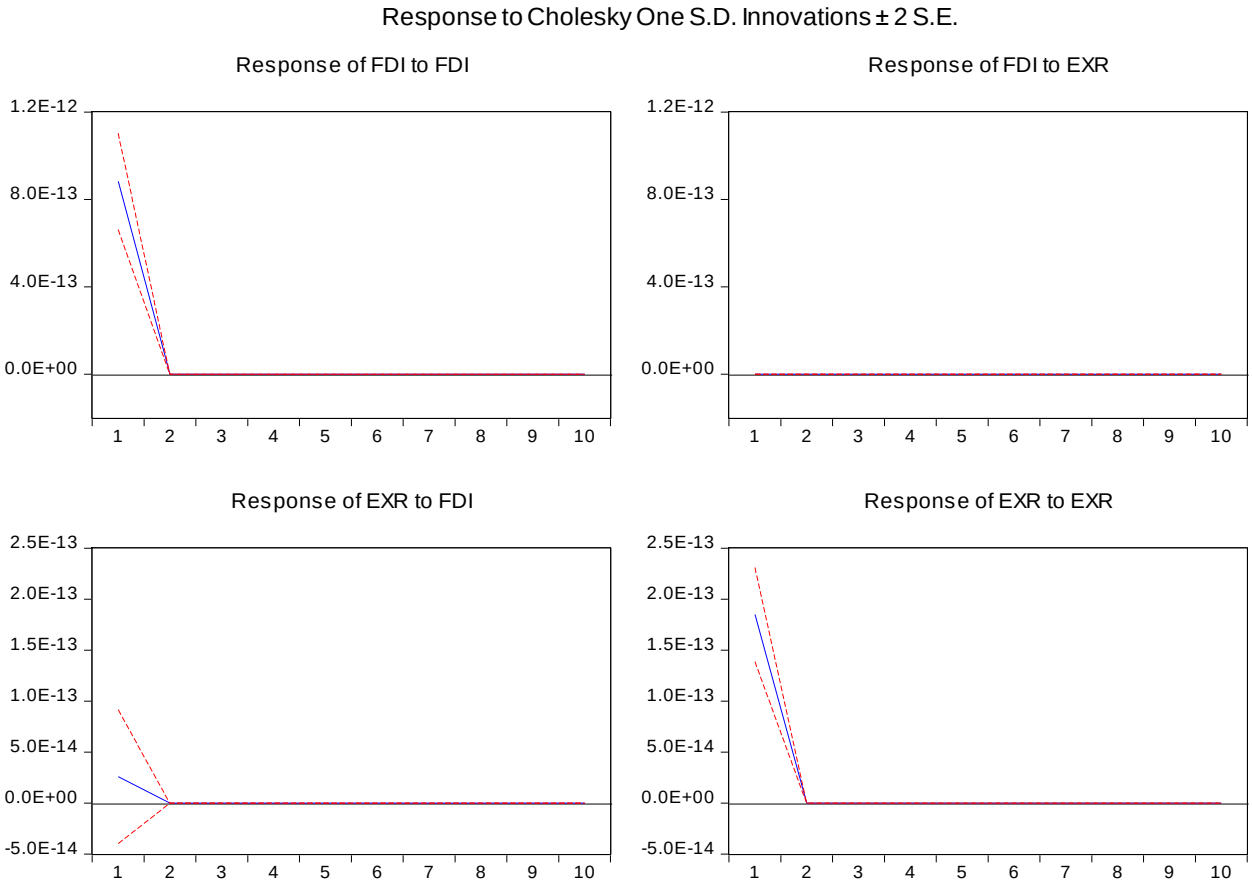

Figure 1: Impulse Response Function

Source: Author's Computation, 2021

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Figure 1 presents the dynamic responses of Foreign Direct Investment (FDI) Inflow into Nigeria to a two-standard-error shock of exchange rate. The effect on exchange rate on Foreign Direct Investment is found to be persistent and significantly positive over a period of up to 8 years after the shock. This implies that a positive exchange rate shock is accompanied by a positive Foreign Direct Investment inflow into the country. However, the effect of exchange rate on Foreign Direct Investment in Nigeria is usually delayed one lag period before becoming asymptotic to the steady state over the time horizon. Exchange rate has a profound effect on Foreign Direct Investment In Nigeria. This is expected because every investor will like to invest in an economy with a relatively stable exchange rate.

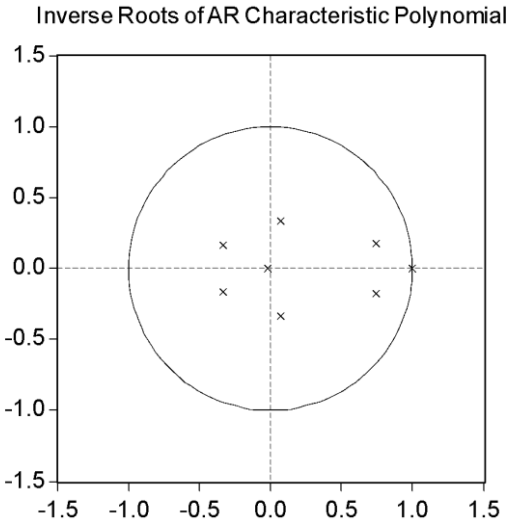

Figure 2: Stability Test Result

Source: Author's Computation 2021.

The stability test conducted is presented in figure 2. The result indicates that no root lies outside the unit root circle. This implies that the estimated impulse response function is not only in a stable mode but efficient in estimating how Foreign Direct Investment (FDI) Inflow into Nigeria responds to an unanticipated shocks in exchange rate.

The implication of these findings to reality is that Foreign Direct Investment (FDI) flows more into an economy that has a stable exchange rate and other related macroeconomic indices. This finding supports the studies of Efiong, Ayuk and Imong (2018); Barguellil, Ben-Salha and Zmami (2018); Iyke and Sin-Yu (2017); Bichanga (2016; Adofu and Adegoriola (2020); Oluremi, Egwaikhide and Ogunleye (2012) among others that exchange rate has a significant and positive influence on FDI. The results of the impulse response function revealed that Foreign Direct Investment (FDI) inflow into Nigeria responds more to exchange rate fluctuation compared to other indices. This finding confirmed the findings of Murtala (2017), who found that exchange rate is a major determinant of Foreign Direct Investment (FDI) inflow into any economy.

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CONCLUSION AND RECOMMENDATIONS

Evidence from the findings of this study, it can be concluded that the exchange rate is highly volatile in Nigeria. In other words, the rate at which Nigerian naira exchanges for a United States dollar is relatively unstable. Furthermore, the result of the study led to the conclusion that an upward fluctuation in exchange rate will bring about an increase in foreign direct investment in Nigeria. That is to say that the Nigerian naira loses value relative to the United States dollar, when more foreign investors channel their investments into Nigeria. Whenever the exchange rate experiences a shock, the shock goes to affect the inflow of direct investment to Nigeria from foreign countries. Lastly, it is concluded that exchange rate, interest rate, trade openness and inflation rate are the major determinants Foreign Direct Investment (FDI) into Nigeria. This in a nutshell means that a change in any of EXR, INTR and INF goes to affect the inflow of FDI into Nigeria.

Based on the conclusion, it is recommended that measures should be taken to further stabilize the dollar to naira exchange rate so as to reduce business failure due to foreign exchange risk for already existing foreign investments in Nigeria. It is also recommended that given the perceived over-valued naira, a deliberate effort towards revaluation of the naira to reflect the true value of dollar to naira exchange rate will obviously increase the exchange rate and as such makes it cheaper to invest in Nigeria by foreign businesses. The government through the Central Bank of Nigeria should adopt an interest rate policy that will lower the cost of borrowing funds as this will bring about higher inflow of foreign direct investment into Nigeria. Finally, the government should implement monetary and fiscal policies that are geared towards stabilizing the inflation rate so as to attract the inflow of foreign direct investment into Nigeria.

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INFLUENCE OF SOLID MINERAL DEVELOPMENT ON ECONOMIC GROWTH IN NIGERIA

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ABSTRACT: *Nigeria's over-dependence on crude oil revenue has exposed the economy to price shocks emanating from vicissitudes in the global oil market, which has accentuated the need for urgent economic diversification. One of such areas that holds the potential for Nigeria's economic diversification is the solid mineral subsector. The study examined the influence of solid mineral development on economic growth in Nigeria, using the Auto Regressive Distributed Lag (ARDL) Approach. Time series data which spanned 1981 to 2019 were used in the study. The study tested for stationarity among the time series while all results were tested at 5 per cent level. The result revealed that Solid Mineral Development exerted an insignificant positive influence on economic growth in the study area. Finally, the study recommended a religious implementation of the solid mineral development plan and the strengthening of regulation, among others, with a view to accelerating economic growth in Nigeria.*

Keywords: Autoregressive Distributed Lag Model, Economic Diversification, Economic Growth, Solid Mineral Development, Unit Roots, Nigeria

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INTRODUCTION

Stakeholders such as policy makers, scholars and successive governments in Nigeria, among others, have continued to express concern over the country's over-dependence on crude oil, which has exposed the economy to price shocks emanating from vicissitudes in the global oil market. Consequently, a number of them have expressed the need for urgent economic diversification. One of such areas that holds the potential for Nigeria's economic diversification is the solid mineral subsector. Currently, the subsector is being largely operated by small miners who employ crude technology.

The solid mineral subsector comprises coal mining, metal ores, quarrying and other minerals (Central Bank of Nigeria [CBN], 2020). Despite the ubiquitous presence of these resources across the federation, the contribution of solid mineral to Gross Domestic Product (GDP) in Nigeria over three decades has not been exciting. For instance, solid mineral output, according to the CBN (2020), dropped from N67.14 billion in 1981 to N29.09 billion in 1990. It further dropped to N21.31 billion in 2000. However, from 2003, the solid mineral output has been on the increase: from N23.20 billion in 2003 to N51.88 billion in 2010 and from N96.60 billion in 2018 to N106.2 billion in 2020 respectively. Nevertheless, when the output is compared in terms of percentage contribution to GDP, CBN (2020) reports that the contribution of solid mineral to GDP has been falling for most part of the period. For instance, it dropped from 0.44 per cent in 1981 to 0.15 percent in 1990 to 0.089 per cent in 2000, and rose marginally from 0.093 per cent in 2010 to 0.15 per cent in 2020.

The pedestrian performance of the solid mineral subsector has been attributed to lack of geosciences data, limited budgetary support, absence of critical infrastructure, federal-state subsidiarity/tensions, illegal mining and community challenges. Others include supervising ministry's weak institutional capacity, limited enforcement of regulations, poor ease of doing business rating and lack of funding, among others (Ministry of Solid Mineral Development, [MSMD], 2016).

In terms of growth, the Nigerian economy which rose from recession in the early 1980's to a growth rate of about 6.4 per cent in 1989, slowed down to an average of 2.6 per cent between 1990 and 1999. Between 2000 and 2014, the GDP grew at an average of 7.9 per cent after which it dwindled to 2.65 per cent and recessed to -1.62 per cent in 2015 and 2016 respectively. This had been followed by a slow recovery, with a growth rate of 0.81% in 2017, and 1.92% growth in 2018 (CBN, 2018). By the end of 2021, National Bureau of Statistics [NBS] (2022) reports that the GDP rose by 3.4 per cent, which was over and above initial forecasts.

In a bid to boost the solid mineral subsector, the Federal Government of Nigeria created the Ministry of Solid Mineral Development in 1999, which has ignited a lot of interest in the subsector. The subsector has also provided alternative sources of foreign exchange to the country in view of the fact that income generation from oil has been unreliable partly due to oil price fluctuations in the global market, the crisis in Niger Delta region of Nigeria (CBN, 2014), and other Resource-Curse factors such as inefficient spending and borrowing, limited capture of benefits and weaker institutional development (Natural Resource Governance Institute [NGRI], 2015).

The question that arises is: How has solid mineral development influenced economic growth in Nigeria? Solid mineral development entails a full range of activities, ranging from exploration through extraction or production of naturally occurring substances or formations

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whose particles are closely packed together and have relatively stable shape and volume. On the other hand, economic Growth is a consistent increase in the value of goods and services produced in an economy over a long period of time (Jhingan, 2014).

A consensus is yet to be established on the influence of solid mineral development on economic growth in Nigeria despite the increased clamour for economic diversification. The study provides a further insight into the solid mineral development - economic growth nexus especially from the developing country context. Findings would assist bureaucrats and governments in crafting solid mineral development policies aimed at driving economic diversification and growth in the country. Hence, the study investigated the influence of solid mineral development on economic growth in Nigeria. The specific objectives of this study were to: examine the long run relationship between solid mineral development and economic growth in Nigeria; determine the influence of solid mineral development on economic growth in the study area; and establish the direction of causality between solid mineral development and economic growth in the study area. A study of this nature is important especially in an economy whose growth has been largely dependent on a single natural resource (crude oil). The scope of the study was limited to the relationship between solid mineral development and economic growth in Nigeria between 1981- 2019. The base year of 1981 was chosen to capture the eras of boom and bust as well as the period when appreciable efforts were made towards economic reforms in Nigeria.

EMPIRICAL REVIEW

A number of researchers have studied the relationship between solid mineral development and economic growth.

For instance, Akongwale, Ayodele and Udefuna (2013) analysed the role of solid mineral on economic diversification in Nigeria, employing both qualitative and quantitative analyses. The study showed that the solid mineral subsector has the potential to contribute immensely to the economy of Nigeria. Specifically, it revealed that the development of the solid mineral subsector could help to combat poverty in the country via job creation; especially, given its forward linkage with other sectors of the economy.

Adeniyi, Adeleke and Olabode (2013) examined solid mineral and economic growth in Nigeria by employing qualitative analysis. The study revealed that the solid mineral subsector remains crucial to economic development, wealth creation and poverty alleviation in any nation that is blessed with such mineral deposits and concluded that Nigeria government should adopt best practices and mechanisms that have been used by different countries to formalise and regulate mining explorations in order to attain sustainable development in the mining subsector in the country.

Danmola and Wakili (2013) analysed the potential of solid mineral resource as a viable alternative to petroleum, which is a volatile and unreliable source of foreign exchange earnings for the country. The study suggested that in partnership with federal, state or local communities the solid mineral subsector can be fully developed with a view to generating substantial foreign exchange for the country. For a developing country such as Nigeria, solid mineral development is expected to be a veritable source of raw materials for domestic industries and a foreign exchange earner in addition to generating employment. Maduaka (2014) also investigated the

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contribution of solid mineral to economic growth in Nigeria from 1970 to 2012. Adopting the Vector Auto Regression (VAR), the finding from the study suggested that solid mineral exerts a positive effect on economic growth in Nigeria.

Furthermore, Udoka and Duke (2017) also empirically examined the influence of three sectors (solid mineral, tourism and agriculture) on Nigeria's economic growth from 1981 to 2014. Employing Ordinary Least Squares (OLS), the study found that solid mineral has a positive and significant influence on economic growth in Nigeria.

In a related study, Edeme, Onoja and Damulak (2018), using a time series data spanning from 1960 to 2015, established that solid mineral has a positive and significant impact on economic growth in Nigeria. Similarly, Ajie, Okoh and Ojiya (2019), using Johansen cointegration test and Ordinary Least Squares (OLS) technique, established that a unit increase in solid mineral development such as quarrying, bauxite, metal ores, iron ore, coal will contribute 0.26 unit to Nigeria's GDP. In the above study, economic growth was proxied by GDP, while solid mineral development was represented by the latter's contribution to GDP.

According to Ajie, Okoh and Ojiya, (2019), while a lot of opportunities exist in mineral development for both the domestic and export markets, minerals mined in the country are still largely exported with little or no value addition. Hence, there are lot of opportunities that exist in mineral development for both the domestic and export markets.

Also, Nwogwugwu *et al.* (2021) investigated the nexus between solid mineral development and economic growth in Nigeria. They employed the canonical cointegration regression (CCR) and empirically found that solid mineral production exerts a significant positive effect on economic growth in Nigeria.

In a related study, Zayone, Henneberry and Radmehr (2020) examined the effect of agricultural, manufacturing, and mineral exports on Angola's economic growth, employing data from 1980 to 2017. An Autoregressive Distributed Lag (ARDL) model was adopted to estimate the effect of sectoral exports on economic growth in the country. Analysis of the findings showed that while exports from all three sectors (manufacturing, mineral, and non-mineral) have driven Angola's economic growth in the long-run; only non-manufacturing exports (agricultural and mineral) have driven GDP growth in the short-run. Furthermore, the study found that mineral exports drove non-export GDP in the long-run whereas agricultural exports drove it in the short-run.

Overall, the current study extends the frontier of knowledge by investigating the influence of solid mineral development on economic growth in Nigeria, which is from a developing country perspective, using a more recent set of data.

Methodology

Theoretical Framework

In examining the influence of solid mineral development on economic growth, this study adopted the endogenous growth theory, which is rooted in the AK growth model. The model is hinged on the assumption that economic prosperity is mainly driven by internal or endogenous factors as opposed to external or exogenous factors.

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Starting with the simple AK model which is of the following form:

$Y = f(AK)$ … (1)

Where Y is the national output, K is the composite measure of capital stock, while A is a constant on the assumption of constant return to scale (CRS). The CRS replaces the assumption of diminishing returns to scale in the neoclassical growth theory to ensure that investment matters for long run growth and that growth is endogenous (Hussien & Thirwall, 2000). But capital stock can be subdivided into physical capital and human capital, hence the model becomes:

$Y = A\ f(K, L)$ … (2)

Where L stands for labour force

This implies that:

$Y = AK + AL$ … (3)

If y = Y/A, then k=K/A, and ⌊ =L/A, then equation (3) can be re-written as follows:

$y_t = \beta_0 + \beta_1 k_t + \beta_2 ⌊_t$

Where; y represents output, k stands for physical capital, and ⌊ is human capital.

It is reasonable to expect that the output in any economy will be influenced in one way or another by the productive use of resources such as solid mineral development, (smid). Hence, there is need to introduce solid mineral development into the equation as follows:

$y_t = \beta_0 + \beta_1 k_t + \beta_2 ⌊_t + \beta_3 smid_t$ … (4)

In order to capture other relevant macroeconomic variables such as exchange rate ($\varkappa_1$) and inflation ($\varkappa_2$), we introduced them into the equation as follows:

$y_t = \beta_0 + \beta_1 k_t + \beta_2 ⌊_t + \beta_3 smid_t + \beta_4 \varkappa_{1t} + \beta_5 \varkappa_{2t}$ … (5)

Model Specification

The main objective of the study was to investigate the influence of solid mineral development on economic growth in Nigeria. Anchored on the endogenous growth theory, the model to achieve this objective takes the following form:

$RGDPGR = f(SMID, GFC, EXR, POPGR, INF)$ … (6)

The above model is explicitly stated as follows:

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$RGDPGR_t = \beta_0 + \beta_1 SMID_t + \beta_2 GFC_t + \beta_3 lnEXR_t + \beta_4 POPGR_t + \beta_5 INF_t + \mu_t$ ... (7)

Where:

RGDPGR = Real Gross Domestic Product Growth Rate as a proxy for economic growth

SMID = Solid Mineral Development proxied by the subsector's contribution to GDP

GFC = Gross Fixed Capital Formation as a proxy for capital

EXR = Exchange Rate

POPGR= Population growth rate as a proxy for labour

INF = Inflation Rate proxied by the consumer price index

β_0 = Intercept parameter or average effect on dependent variable if all the variables are excluded from the model, especially when all the explanatory variables are set at zero values.

$\beta_1 - \beta_5$ = The parameters or partial regression coefficients of the model, measuring the change in the mean value of the RGDPGR per unit change in individual explanatory variable, while holding other variables constant.

μ_t = the stochastic disturbance term that captures the effect of other variables not included in the model on economic growth.

Analytical Techniques

Unit Root Test

To empirically examine the influence of solid mineral development on economic growth in Nigeria, the series were subjected to the unit root test, using the Augmented Dickey-Fuller (ADF) statistic at 5 percent level. The unit root test was carried out to confirm if the series were stationary at level [I(0)] or at first difference [I(1)]. However, the series must not be I(2) to be amenable to the Autoregressive Distributed Lag (ARDL) model. The ADF Test was based on the null hypothesis of non-stationarity. The unit root test is very important in ensuring that a unit root does not exist in the series because the existence of unit root can lead to a spurious regression.

Autoregressive Distributed Lag (ARDL) Model

The ARDL model was originally postulated by Pesaran and Shin (1999) and further extended by Pesaran, Shin and Smith (2001). The optimal lag length (lag 1) was selected on the basis of Akaike information criterion (AIC), using Eviews 9. The ARDL technique rather than the Johansen framework was employed in the study due to its applicability because it does not require all variables to be I(1). Also, it is applicable in cases where there is a mix of I(0) and I(1) variables in the series under study. The robustness of the ARDL method of cointegration is demonstrated in its ease of applicability with respect to the order of integration of the variables (that is when they are I(0) and I(1) but not I(2)); endogeneity assumptions in respect of all variables as well as its ability to simultaneously estimate the short-run and long-run

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coefficients of the model The starting point for the ARDL model is a structure of the following form:

$$\Delta RGDPGR_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta RGDPGR_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta SMID_{t-i} + \sum_{i=1}^{n} \beta_3 \Delta GFC_{t-i} + \sum_{i=1}^{n} \beta_4 \Delta \ln EXR_{t-i} + \sum_{i=1}^{n} \beta_5 \Delta POPGR_{t-i} + \sum_{i=1}^{n} \beta_6 \Delta INF_{t-i} + \beta_7 RGDPGR_{t-1} + \beta_8 SMID_{t-1} + \beta_9 GFC_{t-1} + \beta_{10} \ln EXR_{t-1} + \beta_{11} POPGR_{t-1} + \beta_{12} INF_{t-1} + \varepsilon_t \quad \ldots(8)$$

Where:

Δ denotes the first difference operator;

β_0 is the drift component

ε_t is the white noise residuals.

The left-hand side of the equation represented by RGGDPGR (i.e. the growth rate of real GDP) was used as proxy for economic growth. The first six expressions with the summation sign ($\beta_1 – \beta_6$) on the right-hand side denote the short run dynamics of the model while the last six expressions (($\beta_7 – \beta_{12}$) represent the long run relationship.

The presence of long-run relationship among the variables was conducted using Bounds Test under Pesaran *et al.* (2001) procedure. Based on the F-test, the Bounds Test is based on a null hypothesis of no cointegration among the variables vis-à-vis the alternative hypothesis which states that cointegration (long run relationship) exists among the variables denoted as follows:

H_o: $\beta_7 = \beta_8 = \beta_9 = \beta_{10} = \beta_{11} = \beta_{12} = 0$

This implies no long run relationship (i.e. no cointegration) exists among the variables.

H_1: $\beta_7 \neq \beta_8 \neq \beta_9 \neq \beta_{10} \neq \beta_{11} \neq \beta_{12} \neq 0$

That is, there is cointegration (long run relationship) among the variables**.**

Restricted Error Correction Model

If cointegration is proven to exist, then the third step requires the construction of error correction model to check the dynamic relationship. The *a priori* expectation is that the error correction term (ECT) coefficient must be negative and significant. The purpose of the error correction term is to indicate the speed of adjustment of a departure from long-run equilibrium. However, the greater the coefficient of the parameter, the higher the speed of adjustment. The Error Correction model relating to the variables in equation (8) is as follows:

$$\Delta RGDPGR_t = \beta_0 + \sum_{i=1}^{n} \beta_1 \Delta RGDPGR_{t-i} + \sum_{i=1}^{n} \beta_2 \Delta SMID_{t-i} + \sum_{i=1}^{n} \beta_3 \Delta GFC_{t-i} + \sum_{i=1}^{n} \beta_4 \Delta \ln EXR_{t-i} + \sum_{i=1}^{n} \beta_5 \Delta POPGR_{t-i} + \sum_{i=1}^{n} \beta_6 \Delta INF_{t-i} + \Omega ECT(-1) \quad \ldots. (9)$$

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Where Ω represents the speed of adjustment parameter while the ECT is the vector of residuals obtained from estimated cointegration model in equation (8).

Granger Causality Test

The Granger causality test was also used to examine directional flow of causality between variables which, in its general form, is represented as follows:

$$Z_t = \alpha + \varphi_i z_{t-i} + \varpi_n x_{t-n} + \varepsilon_{it} \quad \ldots (10)$$

Where:

Z_t = Variable whose causality is being investigated.

α = Intercept of the AR(p) process.

φ_i = Parameters of lagged values of z to be estimated.

ϖ_n = Parameters of the x to be estimated

n = Longest lag length for which the lagged values of x has been proved statistically significant.

Data Sources and Measurement of Variables

The study employed secondary data spanning from 1981 to 2019 as detailed in Table 1.

Table 1: Data Sources and Measurement of Variables

Variables	Indicator	Variable Description	Measurement	Source
RGDPGR	Real gross domestic product growth rate	RGDP growth rate as proxy for Economic Growth	Growth rate of Real Gross Domestic Product in percentage	Central Bank of Nigeria, Statistical Bulletin, 2019
SMID	Solid mineral development	Contribution of solid mineral development to GDP	Percentage contribution of solid mineral development to GDP	Central Bank of Nigeria Statistical Bulletin, 2019
GFC	Gross fixed capital formation	Capital formation as proxy for investment in the subsector	Measured as a percentage of GDP	Central Bank of Nigeria Statistical Bulletin, 2019
EXR	Exchange Rate	Proxied by the rate of Naira to the United States of America's Dollar	Natural log of Exchange Rate	Central Bank of Nigeria Statistical Bulletin, 2019

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POPGR	Population growth rate	Population growth rate as proxy for human capital embodied in Labour Force	Growth rate of Population in percentage	World Development Indicators, 2019
INF	Inflation Rate	Inflation Rate as proxied by Consumer Price Index	Year-on-year Inflation Rate measured in percentage	Central Bank of Nigeria Statistical Bulletin, 2019

RESULTS AND DISCUSSION

Result of the Unit Root Test

The result of unit root test conducted on the variables is presented in Table 2.

Table 2: Result of the Unit Root Test

Variable	ADF Test Statistic Level	MacKinnon Critical Value at Level at 5% level	ADF Test Statistic at First Difference	MacKinnon Critical Value at First Difference at 5% level	Decision
RGDPGR	-3.438731*	-2.945842	N/A	N/A	I(0)
SMID	-5.218905*	-2.945842	N/A	N/A	I(0)
GFC	-0.624952	-2.945842	-6.800072*	-2.948404	I(1)
LNEXR	-2.119490	-2.945842	-5.200041*	-2.948404	I(1)
POPGR	-4.840464*	-2.945842	N/A	N/A	I(0)
INF	-2.831565	-2.945842	-5.252626*	-2.948404	I(1)

**Significant at 5% level.*
Source: Authors' Computation, 2021

The result in Table 2 shows that variables RGDPGR, SMID and POPGR are stationary at level since ADF statistics (absolute values) are greater than the critical values at 5 percent level, while GFC, LNEXR and INF are stationary at first difference because the absolute values of the ADF statistics are greater than the critical values at 5 percent level at first difference. Thus, we conclude that the variables RGDPGR, SMID and POPGR are I(0) while others (GFC, LNEXR and INF) are I(1).

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Examination of the Long Run Relationship between Solid Mineral Development and Economic Growth in Nigeria

The study employed the ARDL (Bounds Test) Approach to assess the long run relationship between solid mineral development and economic growth in Nigeria.

Table 3: Result of the Bounds Test

Panel A		
Test Statistic	Value	K
F-statistic	9.753520	5
Panel B	Pesaran *et al.* (2001) critical values	
Critical Value Bounds	I (0)	I (1)
(at 5% Significance Level)	2.39	3.38

Source: Authors' Computation, 2021

From Table 3, it can be inferred that there is cointegration (long run relationship) between the variables as the value of the F-statistic is greater than the upper bound of the Pesaran critical value at 5 percent level. Therefore, we reject the null hypothesis and conclude that there is long run relationship between the independent variables and the dependent variable.

Determination of the Influence of Solid Mineral Development on Economic Growth in Nigeria

The short run and long run ARDL results of the model are presented in Table 4: With an adjusted R^2 of about 0.463, it indicates that the independent variables explain about 46.3 per cent of the variation in the dependent variable while an F-statistic of about 4.10 (Prob. F-stat: 0.001) implies that the overall model is significant at 5 percent level.

As can be observed from the diagnostic tests, the model passed all diagnostic tests against serial correlation (Breusch-Godfrey test) and heteroscedasticity (Breusch-Pagan-Godfrey test). Figure 1 shows the plot of cumulative sum of squares of recursive residuals, which indicates the absence of any instability in the coefficients and a confirmation of normality of errors. This is because the plot of the CUSUM statistic fell within the critical bounds of the 5 percent significance level of parameter stability.

Table 4: Result of ARDL Estimation

Variable	**Coefficient**	**t-Statistic**	**Prob.**
D(RGDPGR(-1))	-0.073504	-0.497511	0.6234
D(SMID(-1))	0.509877	1.806179	0.0834
D(GFC(-1))	-0.002359	-1.179805	0.2496
D(LNEXR(-1))	0.144266	2.667352	0.0135*
D(POPGR(-1))	108.4335	2.311536	0.0297*

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D(INF(-1))	0.001154	2.630689	0.0146*
RGDPGR(-1)	0.191314	1.184836	0.2468
SMID(-1)	0.057452	0.234859	0.8162
GFC(-1)	-0.002970	-1.409878	0.1704
LNEXR(-1)	0.079251	1.850397	0.0757
POPGR (-1)	73.83486	2.467202	0.0205*
INF(-1)	0.000829	1.847477	0.0761
C	0.000857	0.117333	0.9076
R-squared	0.612264	F-statistic	4.105594
Adjusted R-squared	0.463135	Prob (F-stat)	0.001805
Durbin-Watson Stat:	1.998505		
Diagnostic Tests			
Breusch-Godfrey Serial Correlation LM:	3.977985	Prob (F-statistic)	0.0571
Breusch-Pagan-Godfrey Heteroscedasticity	Obs*R-squared : 21.47	Prob (F-statistic)	0.1930

** indicates 5% level of significance*

Source: Authors' Computation, 2021.

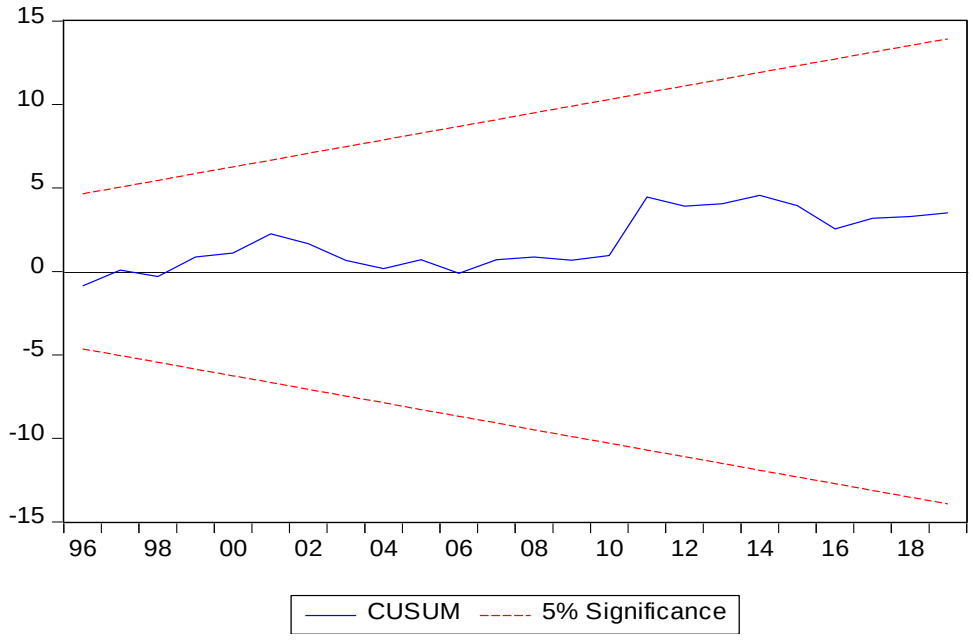

Figure 1: Plot of Cumulative Sum of Recursive Residuals of the model

Source: Authors' Computation, 2021

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Furthermore, Table 4 reveals that solid mineral development exerts a positive but insignificant influence on economic growth at 5 percent level in the short run. It is worth noting that the positive influence exerted by solid mineral development on economic growth is even weaker in the long run. The implication of these findings is that the output generated from solid mineral development is either not large enough to significantly drive economic growth in Nigeria or it is done illegally without entering government records. These findings contrast those of Udoka and Duke (2017), and Nwogwugwu *et al.* (2021) who suggested that solid mineral development exerts a significant positive effect on economic growth in Nigeria. However, the findings of this study corroborates CBN (2020) which reports that the contribution of solid mineral to GDP has been falling for most part of the period covered by the study. For instance, it dropped from 0.44 per cent of GDP in 1981 to 0.15 percent in 1990 to 0.089 per cent in 2000, and rose marginally from 0.093 per cent 2010 to 0.15 per cent in 2020. Hence, there is need for government to ensure the implementation of the solid mineral development plan while regulation of the subsector may require strengthening in order to minimize leakages.

The result in Table 4 also reveals that capital formation exerts a negative but insignificant influence on economic growth at 5 percent level in the short run as well as in the long run. The implication is that capital formation has not been effectively deployed in the country. This finding contrasts that of Ugwuegbe and Uruakpa (2013) who found that capital formation exerts a significant positive influence on economic growth in Nigeria. Hence, Government may need to review its capital formation strategies.

The result also indicates that exchange rate exerts a positive and significant effect on economic growth in the short run at 5 percent level, which pales into insignificance in the long run. This implies that the exchange rate management in Nigeria is not beneficial in the long run. This finding is in tandem with that of Akpan and Atan (2011) who reported that exchange rate does not have a direct influence on economic growth in the country. The result also reveals that labour force exerts a significant positive effect on economic growth at 5 percent level both in the short run and long run. This implies that labour force has been an asset to the country during the period. This finding is in line with that of Yakubu, Akanegbu and Jelilov (2020) who found that labour force exerts a significant positive effect on economic growth in Nigeria.

Table 4 also indicates that inflation exerts a significant positive effect on economic growth in the short run but the effect becomes insignificant in the long run. This implies that inflation management only drives short run increase in GDP but it is ineffective in the long run. This finding is consonance with that of Ogu, Adagiri, and Abdulsalam (2020) who stated that inflation does not drive economic growth in the long run. These findings suggest that the Central Bank of Nigeria may need to review its inflation and exchange rates management policies with a view to enabling them to significantly drive economic growth in the long run in the country.

The coefficient of the ECT(-1) is -1.074 and is statistically significant at 5 percent level (Table 5). It indicates that any departure from long run equilibrium is fully corrected within one year. This implies that the speed of adjustment is very high. The significance of the Error Correction Term (ECT) provides further evidence on the long-run cointegration dynamics that exists between Real GDP Growth Rate and its regressors in the model.

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With an adjusted R^2 of about 0.810, it indicates that the independent variables explain about 81 per cent of the variation in the dependent variable while an F-statistic of about 4.10 (Prob. F-stat: 0.0004) implies that the overall model is significant at 5 percent level.

The result of the Diagnostic Tests shows that the model passed all diagnostic tests against serial correlation (Breusch-Godfrey test) and heteroscedasticity (Breusch-Pagan-Godfrey test). The plot of cumulative sum of squares of recursive residuals in Figure 2 indicates the absence of any instability in the coefficients. It is also a confirmation of normality of errors as the plot of the CUSUM statistic lies within the critical bounds of the 5 percent significance level of parameter stability.

Table 5: Result of the Restricted Error Correction Model

Dependent Variable: D(RGDPGR) Method: ARDL Proxy for Solid Minerals Development: SMID			
Variable	Coefficient	t-Statistic	Prob.
ECT (-1)	-1.073504	-9.238144	0.0000*
D(LNEXR(-1))	0.144267	2.667352	0.0135*
D(POPGR(-1))	108.4336	2.311536	0.0297*
D(INF(-1))	0.001155	2.630689	0.0146*
R-squared	0.837849	F-statistic	9.753520
Adjusted R-squared	0.810824	Prob (F-statistic)	0.000445
Durbin-Watson Stat:	2.015455		
Breusch-Godfrey Serial Correlation LM: F-Stat	0.9322	Prob (F-statistic)	1.0030
Breusch-Pagan-Godfrey Heteroscedasticity	Obs*R-squared : 16.83	Prob (F-statistic)	0.1570

Source: Authors' Computation (2021)

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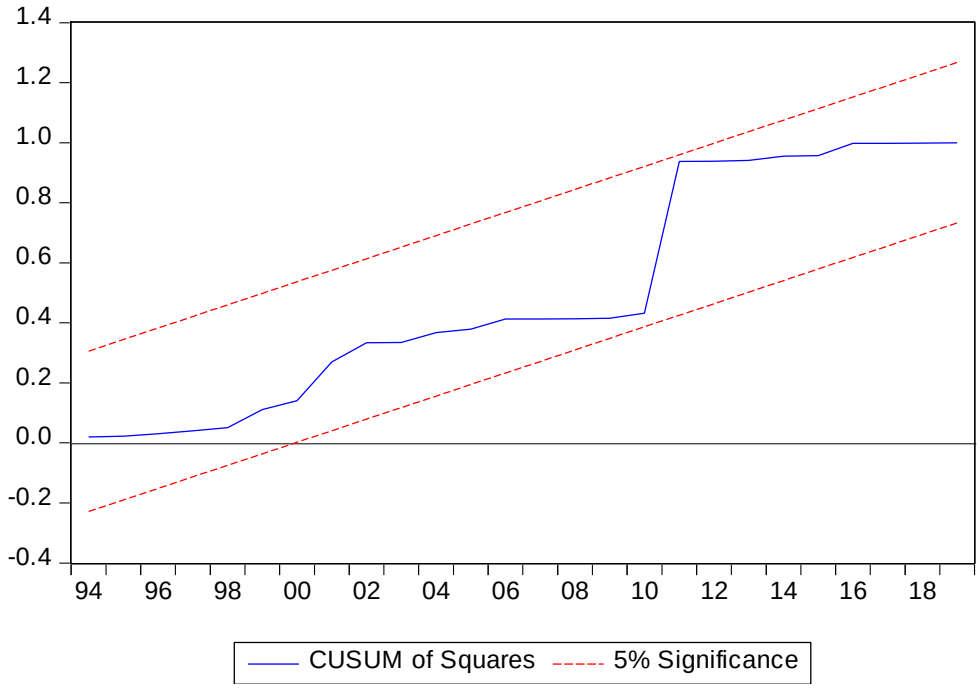

Figure 2: Plot of Cumulative Sum of Recursive Residuals of the Restricted Error Correction Model

Source: Authors' Computation, 2021

Direction of Causality between Solid Mineral Development and Economic Growth in Nigeria

Table 6 presents the result of long run Granger causality test (GCT) between the dependent and independent variables.

Table 6: Result of Granger Causality Test

Pairwise Granger Causality Tests			
Date: 07/15/21 Time: 15:57			
Sample: 1981 2019			
Lags: 1			
Null Hypothesis:	Obs	F-Statistic	Prob.
SMID does not Granger Cause RGDPGR	37	2.26436	0.1416
RGDPGR does not Granger Cause SMID		0.45532	0.5044
GFC does not Granger Cause RGDPGR	37	1.30862	0.2606
RGDPGR does not Granger Cause GFC		0.56134	0.4589
LNEXR does not Granger Cause RGDPGR	37	1.12229	0.2969
RGDPGR does not Granger Cause LNEXR		0.24265	0.6255

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POPGR does not Granger Cause RGDPGR	37	0.15340	0.6978
RGDPGR does not Granger Cause POPGR		6.23698	0.0175*
INF does not Granger Cause RGDPGR	37	0.71291	0.4044
RGDPGR does not Granger Cause INF		1.04408	0.3141
GFC does not Granger Cause SMID	38	2.05255	0.1608
SMID does not Granger Cause GFC		0.49331	0.4871
LNEXR does not Granger Cause SMID	38	0.01527	0.9024
SMID does not Granger Cause LNEXR		0.74256	0.3947
POPGR does not Granger Cause SMID	37	2.37504	0.1325
SMID does not Granger Cause POPGR		2.08619	0.1578
INF does not Granger Cause SMID	38	2.39562	0.1307
SMID does not Granger Cause INF		0.22039	0.6417
LNEXR does not Granger Cause GFC	38	2.03154	0.1629
GFC does not Granger Cause LNEXR		0.00595	0.9389
POPGR does not Granger Cause GFC	37	4.04697	0.0522
GFC does not Granger Cause POPGR		2.07293	0.1591
INF does not Granger Cause GFC	38	0.22555	0.6378
GFC does not Granger Cause INF		0.43311	0.5148
POPGR does not Granger Cause LNEXR	37	0.02726	0.8698
LNEXR does not Granger Cause POPGR		0.74382	0.3945
INF does not Granger Cause LNEXR	38	0.88995	0.3520
LNEXR does not Granger Cause INF		0.34894	0.5585
INF does not Granger Cause POPGR	37	3.45803	0.0716
POPGR does not Granger Cause INF		0.00361	0.9524

** Significant at 5% Level*

Source: Authors' Computation, 2021

The focus was on the causal relationship between Solid Mineral Development and Economic Growth in Nigeria. The null hypotheses state that solid mineral development (SMID) does not Granger-cause economic growth (RGDPGR), and economic growth (RGDPGR) does not Granger-cause solid mineral development (SMID). The result in Table 6 indicates that these two null hypotheses should be accepted as directional causality neither runs from solid mineral development to economic growth nor from economic growth to solid mineral development at 5 percent level of significance. These imply that solid mineral development neither directly drives nor is it directly driven by economic growth in Nigeria. However, causality runs from

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economic growth (RGDPGR) to labour force (POPGR). This implies that economic growth drives labour force in Nigeria.

CONCLUSION AND RECOMMENDATIONS

The study empirically examined the influence of solid mineral development on economic growth in Nigeria, using annual time series data from 1981 to 2019. The result revealed that Solid Mineral Development exerts a weak positive effect on Economic growth in the study area. This result was buttressed by granger causality test which indicates that neither solid mineral development nor economic growth granger-causes each other. This is an indication that the solid mineral subsector is yet to be given a pride of place in the country as evidenced by its weak influence on economic growth. It also suggests the existence of a high level of illegal activities and leakages in the subsector.

Based on findings from the study, the following recommendations are hereby put forward:

i. Government should ensure a religious implementation of the solid mineral development plan in order to accelerate a sustainable solid mineral production and thereby speed up economic growth in the country.

ii. The Ministry of Solid Mineral Development should strengthen its regulation of the solid mineral subsector in order to exterminate illegal activities and minimise leakages.

iii. Government should review capital formation with a view to ensuring a productive deployment of capital in the country.

iv. The Central Bank of Nigeria should review its management of inflation and exchange rates with a view to enabling them drive economic growth in the long run.

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THE AFRICAN STATE AND SUSTAINABLE DEVELOPMENT GOALS: A PUBLIC POLICY PERSPECTIVE

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ABSTRACT: *Sustainable development is an idea of global awareness about the demand for natural resources for growth and development with obvious consequences on the environment, especially for the future. The idea now has a 17-goal agenda, which was adopted in January 2015, by the UNDP to be achieved within a time frame of 15 years, from 2015 to 2030. Even though Africa is not on the same level as the global North, in terms of development, all African countries now embrace the idea. Using public policy as a perspective in understanding the implementation of the 17 goals, because all the 17 goals are policy issues and the state is central to policy formulation and implementation, this paper, therefore, interrogates the nature of the African state in order to see the extent to which African countries can achieve the 17 goals. The paper observes that the nature of the African state must be put in a proper perspective in order to understand why African countries may not achieve even one of the 17 goals within the 15- year time frame. This is because the state is today, the problem with the African development process, for being in crisis and for operating with very weak institutions.*

KEYWORDS: African State, Sustainable Development, Public Policy, Capacity Building.

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INTRODUCTION

For some decades now, the idea of sustainable development has assumed a part of the global discourse on development strategies. The growth and development process became a matter of concern when it was observed that the modern industrial development strategies, with the massive industrial expansion, are consuming so much of natural resources that pose a threat to nature's ability to reproduce the resources as they are being consumed. Consequently, it was agreed that if the trend goes on without caution, there will be a conflict between the environment and development needs. It was against that background that the idea of sustainable development became part of development strategies, with a view to being sensitive to the continuous depletion of natural resources and its concomitant consequences for the future. Thus, in January 2015, the UNDP came up with 17- point sustainable development goals (17 SDGs) to be achieved within a time frame of 15 years, from 2015 to 2030.

And because the idea of sustainable development is a global idea, it is being embraced by African countries not minding the fact that they are not on the same level of development as the global North.

In this paper, therefore, an attempt is made to see how the 17 SDGs will be achieved within a 15 year – time frame, from 2015 to 2030 by African countries. Using public policy as a perspective in understanding the implementation of the 17 goals, because all the 17 goals are policy issues and the state is central to policy formulation and implementation, this paper interrogates the nature of the African state in order to see the extent to which African countries can achieve the 17 goals.

The paper starts with some brief conceptual notes on the concept of sustainable development after which the concepts of public policy, strategic planning, the state and capacity building were also briefly discussed in order to link the four concepts to the process of achieving the 17 SDGs. Finally, the paper concludes by examining the nature of the African state in relation to public policy, strategic planning and capacity building. And that is because the nature of the African state must be put in proper perspective in order to understand why African countries may not achieve even one of the 17 goals within the 15- year time frame because the state is today, the problem with the African development process, for being in crisis and for operating with very weak institutions.

Sustainable Development: Some Conceptual Notes

Capitalism, as a mode of production, has always been characterised by continuous expansion in order to meet development strategies. And the process of capitalist expansion in meeting industrial needs for development requires heavy demand for resources, such as agricultural outputs like wood, cotton, timber, oil, and coal, all of which depend on the increasing use of the land, sea and even the atmosphere. Consequently, there is a conflict between development strategies that relentlessly demand resources and nature's limited available resources. (Snarr & Snarr, 2012). In other words with capitalism and the ideas of development, which aim at improving the wellbeing of society, through industrial processes, the industrial processes that continually require more and more resources, a conflict between ecology and economics becomes inevitable.

Thus, if the modern idea of development, with its dynamics, is to stop fueling the inevitable conflict between ecology and economics, policymakers will have to embark on substantial

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modifications to their strategies and their assumptions about development plans, so that development will be sustainable (Snarr & Snarr, 2012). It is against this background that the idea of sustainable development became a global concern in terms of discussing the environmental consequences of economic growth and development with particular reference to the continuous depletion of natural resources. In other words, focusing on the depletion of natural resources and its concomitant consequences for the future becomes the underlying definition of sustainable development.

Although the idea of sustainable development is a controversial one, as there is no general agreement as to what it means, it is, however, pertinent to say that common ground in all the definitions and positions of scholars about the idea of sustainable development is the reconciliation or better still, the management of the inevitable conflict between ecology and economics. Thus, sustainable development will simply mean a concerted effort that involves many global actions, from the development of concepts to the negotiation; monitoring, and financing of action plans for the management of the conflict between ecology and economics. In other words, it is that man should be conscious of the danger between capitalist expansion with the needs and requirements of development and the protection of the environment. Thus, sustainable development is primarily about embarking on development efforts while at the same time paying attention to environmental protection for sustaining resources that are necessary to provide for the needs of future generations of life on the planet. It is, therefore, a process that envisions a desirable future for human societies in which living conditions and resources continue to meet human needs without undermining the "integrity, stability and beauty" of natural biotic systems (Brundtland, 1987).

Sustainability, therefore, can be defined as the practice of reserving resources for future generations without any harm to nature and other components of it. Sustainable development ties together the concern for the carrying capacity of natural systems with the social, political and economic challenges that are faced by humanity. It can also be defined as any construction that can be maintained over a long period of time without damaging the environment while man's current interests in the use of resources should not jeopardize the interest of future generations. (Brundtland, 1987 Report).

The most quoted definition of Sustainable Development is the one by UN World Commission on economics and development. It says:

> Sustainable Development is a development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Thus, sustainable development is about meeting human development objectives and also making sure that doing so does not, in any way, decrease the ability of the environment to provide the needed resources for human future needs. In other words, sustainable development refers to the many processes and pathways for sustainability, which is about the future in which human activities in the environment are balanced in the pursuit of improved quality of life. (en.unesco.org/theme education).

Although, the idea of sustainable development has been criticized for asking the question of what is to be sustained in sustainable development, however, this criticism does not remove the idea that society continues to embark on the development process by making use of

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environmental resources that may be irreversible. Therefore, while it is possible that we may be able to find ways to replace some natural resources, it is much more unlikely, if not impossible, in some cases, that some can ever be replaced. (en.unesco.org).

Dimensions of Sustainable Development

Sustainable development has been described in terms of some dimensions, domains or pillars that should be taken care of, in order to protect the future of humanity. These dimensions are *ecology, environment, agriculture, energy, technology, couture, institutions and governance*. In other words, by taking good care of the above dimensions, i.e. making positive use of them, devoid of abuse, will make it possible for sustainable development to be achieved, which is organizing economic activities to promote growth and development and at the same time protecting the environment by focusing on the importance of identifying and respecting environmental limits. (Lamborn &Lepgold, 2003). Thus, sustainable development simply means ensuring development, which is a continuous (sustain) process of growth towards self-reliance and contentment that embodies a strong, healthy and just society. It is about improving the ways things are done, both for the present and for the future in order to promote personal wellbeing, and social cohesion and create equal opportunity for all (development). It is about holistic thinking, a systematic approach to development which aims at achieving a well-defined outcome in terms of making a society responsible, on a continuous basis, for human livelihood, welfare and the future. To realize sustainable development, therefore, there must be strategic plans, capacity building and strong institutions while the role of the state must be seen as extremely crucial.

Sustainable Development Goals, Strategic Planning,

Capacity Building and the State.

The Sustainable Development Goals

In September 2015, as part of the 70th session of the United Nations General Assembly, the organization adopted what was termed Sustainable Development Goals (SDGs) which were a global development agenda. At that meeting, the UN adopted a set of 17 goals which imagines a future that would be rid of poverty and hunger and a world that will be safe from the worst effects of climate change.

The set of 17 goals was objectives form of a programme of sustainable universal and ambitious development. (*en.unesco.org/sustainabledevelopmentgoals*).

The set of 17 goals had the UNDP as one of the leading organisations that will work towards the realization of and fulfilment of the goals by the year 2030.

The SDGs embody different policies with emphasis on their process of actualization and not just the end result. (Mayanja and Nkata, 2019). The adopted SDGS in September 2015 became a programme of 15-year development agenda for the eradication of poverty which today constitutes the greatest challenge to mankind. And without facing poverty for its eradication, sustainable development will be difficult to attain. The 17 goals of the SDGs are, (1) no poverty, (2) zero hunger, (3) good health and wellbeing, (4) quality education, (5) gender equality (6) clean water and sanitation (7) affordable and clean energy (8) decent work and economic growth (9) industry, innovation and infrastructure (10) reduced inequalities (11)

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sustainable cities and communities (12) responsible consumption and production (13) climate action (14) life below water (15) life on land (16) peace, justice and strong institutions (17) partnership for the goals.

Thus, from the above, the role of the state becomes very crucial and central to the realization of the set of SDGs. And that is because the goals are all policy issues and the state is the institution that is very central in policy formulation and implementation.

Strategic Planning

Strategic planning is the process of looking into the future and identifying trends and issues against which to align priorities. (UNDD) It is about understanding the challenges, trends and issues associated with a problem and then determining the most effective and efficient way possible to achieve a set of goals for solving the problem. Strategic planning is a process of defining major goals and objectives and also developing some long-term strategies in a purposeful way that will ensure a high level of performance (Paister, 2003).

Again, strategic planning is the conscious selection of policies, the development of capability and the interpretation of the environment in order to be focused and also be able to position collective efforts toward the achievement of a set of objectives. (Shafritz, Russell and Borick, 2007).

Strategic planning is an effort that is aimed at creating or updating the actions that are contained in a set policy or in a vision. Indeed, strategic planning is a systematic process of envisioning a desired future that leans heavily on the concept of a strategy which is about achieving a set goal in the most effective and efficient manner possible (UNDP). Thus, one of the aims of strategic plans is to guide the delivery of an overall objective and direct a multi-task of work. Strategic plans, therefore, integrate, drive and connect all inputs to a common model of framework. (UNDP).

Strategic plans must embody the following:

- A clear statement of intent reflects the vision and mission of the government.
- Understand the need for a strategic plan.
- Well defined set goals.
- Identification of opportunists, threats and other critical factors.
- Identification of strengths, weaknesses and competencies.
- Relevance of the conditions to make strategies relevant.
- Availability of funds and other resources.
- A well-articulated process of implementation.
- Identify different ways to achieve set objectives.
- Design a relevant plan of action.
- The time frame for evaluation.

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In other words, four critical considerations must be taken note of

- Scope (is it too much or too little)
- Means (How does government achieve the goals i.e. what instruments to use)
- Resources (Funds, personnel, infrastructures)
- Institutional structure (Assembly, L/G) Inter-governmental relations).

Indeed, the primary purpose of strategic planning is to set overall goals for objectives and also develop a plan to achieve them. Therefore, if Africa is to achieve the aims of sustainable development, the state must come up with a strategic plan.

Capacity Building

Capacity building is the process of developing and strengthening the skills and abilities including the processes and the resources that an organization needs to survive. It is also about capacity development which is the development that focuses on the understanding of the obstacles that inhibit people, government or any institution from realizing their developmental goals. In other words, it is about the enhancement of the abilities that will allow people or institutions to achieve measurable and sustainable results. (www.definitions.not/defintion/capacitybuilding).

Capacity building is an intervention that strengthens an organization or institution's ability to fulfil its mission by providing sound management, strong governance and persistent rededication to achieving results. (Bealey and Shebby, 2010). Thus, in its wide context, capacity building is about the ways and means by which the overall goals are achieved. (Stig Enemark, 2003). Consequently, capacity is the ability of an institution or organization to perform its functions effectively, efficiently and sustainably. Thus, capacity is the power of something, a person, an organisation or an institution to perform and produce positive results. (Sting Enemark, 2003). Indeed, capacity building is not a one-time effort to improve short-term effectiveness, but a continuous improvement strategy toward the creation of a sustainable and effective institution or organization (www.commitofnonprofits.ng).

Capacity building is doing whatever is necessary and needed to equip a society so that it becomes more efficient and productive and is able to advance itself into the future. It must be a conscious effort of strategy for improvement, on a continuous basis, for sustained effectiveness, growth and development. In other words, capacity building is about an intentional, well-coordinated mission/vision, a driven effort, that is aimed at strengthening the society for improved performance and positive impact. It is about using institutions with the aim of sustaining order and good governance to ensure popular participation and equip the people with the capacity to exploit their potential and the resources in their environment for the betterment of their society. Capacity building is essential for people in order to make them acquire the skill that will enable them to manage, adjust and respond to the dynamics of future developments. Thus, capacity building must be people-focused and oriented to be carried out through institutions.

Capacity building is therefore a policy process that gives definition and meaning to the fact that people must be well empowered in order to make them achieve development on a

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sustainable basis. And because it is a policy-driven strategy, it is also a class project, developed and carried out by the state, on a well-defined and articulated ideology.

Thus, strategic planning and capacity building are both policy strategies that the state must adopt in order to achieve the SDGs for long term sustainable development.

In other words, to meet sustainable development objectives, the state must develop strategic plans and capacity building with strong institutions.

The State

Quite a number of theories have been propounded, which aim at explaining the evolution, emergence or origin of the state. There are such theories as patriarchal, evolutionary, historical, matriarchal, anthropological, Marxist/Force, social contract, divine, and natural. Today, the dominant issue in politics is the state, precisely because the state is the central focus of political theory and political analysis. Indeed, the state is so central in any development discourse.

Although the concept of state is very current in the social sciences, it is worth noting that different theorists view the state in the background of their respective ideologies and attitude which is why the concept of state is different from period to period and from age to age, from Plato to Marx (Das, 2009). It is also agreed that the exact source and time of origin of the state is not known, the movement of thoughts about the concept can be outlined as follows, from Divine, Evolutionary, Natural, Social Contract and Force Theories. However, the emphasis here shall be on the Marxist/Force theory.

The Marxist/Force theory is neither about the divine, evolutionary or natural origin of the state nor is about the strong people subjugating the weak in society. This is where Marx makes his significant contribution to the concept of the state. Thus, to Marxist/Force theory, the state neither originates in the will of society nor it is maintained for the benefit of all sections of society, because the state does not come into existence for the fulfilment of a moral purpose, nor does it emanate from the will of the people because the origin of the state is as a result of conflict and the state then operates as an instrument of domination, the domination of the weak by the powerful. (Mahajan, 2014).

The theory considers the emergence of the state in terms of events and actions that arise in the process of social production, which is why the state has little to do with representative institutions; rather, the state is something through which the will of the ruling class is imposed on the rest of the people (Burns, 1957). Again, the theory believes that it is always a particular class that plays the leading part in establishing and then consolidating a given economic system and this particular class is able to do so because of its ownership of the means of production and its control, through the state. It can therefore be argued that property owners created a force within the society and the force became the instrument that is used for governance and that is because force is applied in implementing taxation, ensuring obedience to the law and policy implementation. It is, therefore, logical to argue that the state was created by the dynamics of socio-economic production which is maintained and sustained by force.

The modern state is therefore a creation of capitalism which developed with the coming of industry and of complicated commercial arrangements and, with large scale economic operations, the modern complex economic activities, the capitalists needed to stay in control and dominate society. Thus, the state emerged, as an institution and also an instrument of power

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for the capitalists, which is why the state is an institution that represents politics and power on behalf of the property class. (Shively, 2012). Thus, Marxists see the state, its powers, with its corresponding ideology as what constitutes the guardian of property (Comforth, 1962). Therefore, the state is closely identified with what is called the ruling class (Weldon, 1962). Consequently, wherever there is a class struggle (conflict), there is a need for a state (Lukais, 1991). Thus, the state produces hegemonic ideology in terms of exercising a dominance of ideas in society. Today, the modern state remains a most significant force in shaping the economy of the society, thereby making it play an important role in the development of modern society. (Dicken, 2003). It is against this background that the Marxist/Force theory is believed to be most appropriate in explaining the concept of state, in so far as the economically powerful group controls the means of production. Indeed, this was the type of state that was imposed on African countries by colonialism and it was the same colonial state that African countries inherited at flag independence.

Consequently, for this paper, the Marxist/Force theory of the state, using the Marxian perspective in the analysis of the state has been adopted. So, any reference to the state in this work refers to the Marxian idea of the state. My choice of state is based on the fact that today, it is the Marxian type of state that is struggling to emerge in Africa and also because the state, in modern society is the major locus of power and authority.

Sustainable Development Goals, Public Policy and the State.

Sustainable Development Goals

As earlier noted, the concept of sustainable development focuses attention on finding strategies to promote development in ways that degradation, pollution overexploitation of natural resources of the environment, will be avoided (Baylis & Smith 2006). It is an idea that represents human efforts to harmonize human activities and the natural world so as to be able to conserve the earth's stock of resources and its broader ecological support systems (Lambarn & Lebgold, 2003).

The World Bank (cited in Lewellen, 1995), realizing the crucial role of the state toward the achievement of sustainable development especially the 17 SDGs came up with the following seven important ways. These are:

- Environmental considerations must be built into the policy-making process.
- Reduction in population growth should be a priority
- Even though sustainable development is a global agenda, local problems should be attacked first
- The administrative cost of environmental protection should be minimized by setting realistic goals.
- Although the need for trade-offs between the economic, social and biological spheres cannot be avoided, such trade-offs should be made after careful analysis.
- Governments need to conduct research on environmental problems and ensure that the research results reach relevant administrators and even the general public.

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- The adage that "prevention is cheaper than cure" should be kept in mind because it is easier to protect the environment than face the irreparable damage later.

From the above, it is clear that all the seven ways by which sustainable development goals can be achieved are all policy issues which make public policy a clear factor in the global efforts toward achieving sustainable development goals.

Public Policy

According to Eagles & Johnston, (1999) people look to the state to solve problems or take action on pressing issues. Again it is agreed that the political process throws up a lot of demands on the state which makes the state to be an ensemble of resources, organized for solving problems. Consequently, increasing focus, nowadays, has been on this problem-solving activity of the state (Eagles & Johnston, 1999). Thus, David Easton says that politics is the "authoritative allocation of values for a society" and to Lasswell, politics is "who gets what, when and how". What both Easton and Lasswell are saying is that politics is used in resolving conflicting interests and values and that from among the numerous competing interests in society, the actions of government, on behalf of the state will determine which values/interests will prevail.

It is against this background that public policy can be seen as what public officials within government choose to do or not to do about public problems (Kraft & Furlong, 2007). And public problems here mean any conditions that the public perceives to be unacceptable and therefore require state intervention. In this instance, therefore, environmental degradation, pollution and threats to wildlife all call for state action. Thus, public policies result from decisions made by the government.

Public policy can therefore be defined as a course of government action or inaction in response to public problems (Kraft & Furlang, 2007). Again, Leslies Pal, cited in (Eagle and Johnston, 1999) says that public policy is a course of action or inaction chosen by public authorities to address a given set of problems. Again, public policy is an instrument through which societies regulate themselves. Therefore, policy reflects a society's most important values and which of the many different values are given the highest priority in any given situation. However, the most often quoted definition of public policy is by Thomas Dye (1972) which is "anything government chooses to do or not to do".

From the above, two important points need to be emphasized in order to appreciate how crucial the state is to the idea of public policy. The first point is that the agent or institution for public policymaking is the government. Consequently, talking about public policy is talking about the action of the government. Second, it is obvious from the above definitions and analyses of public policy that public policies involve a fundamental choice on the part of the government, to do something or to do nothing (Howlett & R. Ramesh, 2003).

The role of the state

Although there is no agreement on a particular definition of the state nor is there an agreement on its basic functions, however, one feature on which there has been an agreement is that by the nineteenth century, the state had become a key political actor in any capitalist society. What that means is that since that time, the power of the state is exercised directly over a certain territory and its population. Thus, the state now possesses public power that is exercised by its

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special institutions, making it a political super-structural organization of power with political supremacy as well. (Johari, 2012). Consequently, we may not all agree on the definitions and nature of the state and the state may appear to us as highly abstracted, it nevertheless imposes its will on all of us through its institutions, especially the government. In other words, one thing is clear about the state, and that is, today the state has a direct influence on all our lives. And, in actual practice, the way it functions, the state is represented by the government. (McAuley, 2003). Again, the government exercises all its functions with authority, on behalf of the state, which ultimately makes the government an essential organ of the state. (Gauba, 2007). Thus, whenever we are referring to the state, we are speaking of an institution, of which government is the administrative organ. (MacIver, 1965).

As noted earliest, public policies are designed by governmental bodies to accomplish specific goals and produce definite results. In other words, policies involve what governments actually do and not merely what government officials say they will do (Anderson, 2015). Thus a public policy is about a fundamental choice on the part of the government, which is why Thomas Dye says that the agent of policymaking is the government and when we talk about public policies, we speak of the actions of governments, cited in (Howlett & Ramesh, 2003). Here lies the connection between public policies, government and the state.

In the case of sustainable development, which is the focus of this paper, the role of the state is very crucial in the realisation of the 17 SDGS. This is because the 17 SDGs are all policy issues, in so far as they are expected to be articulated as programmes to be implemented and get the desired results. Consequently, for sustainable development goals, the state will work through its institutions, in particular, the government, to formulate a broad policy for meeting the 17 SDGs objectives. And in order to make the policy workable and achievable, the policy must embody well-articulated strategic planning and capacity building programmes.

Fig. 1 below illustrates the interactive process of the state and public policy for sustainable development goals with strategic planning and capacity building programmes that will assist in strengthening the policy and also seeing to its successful implementation and outcome. The public policy on the 17 SDGs must also have an inbuilt mechanism for evaluation, the result of which will be communicated back to the state.

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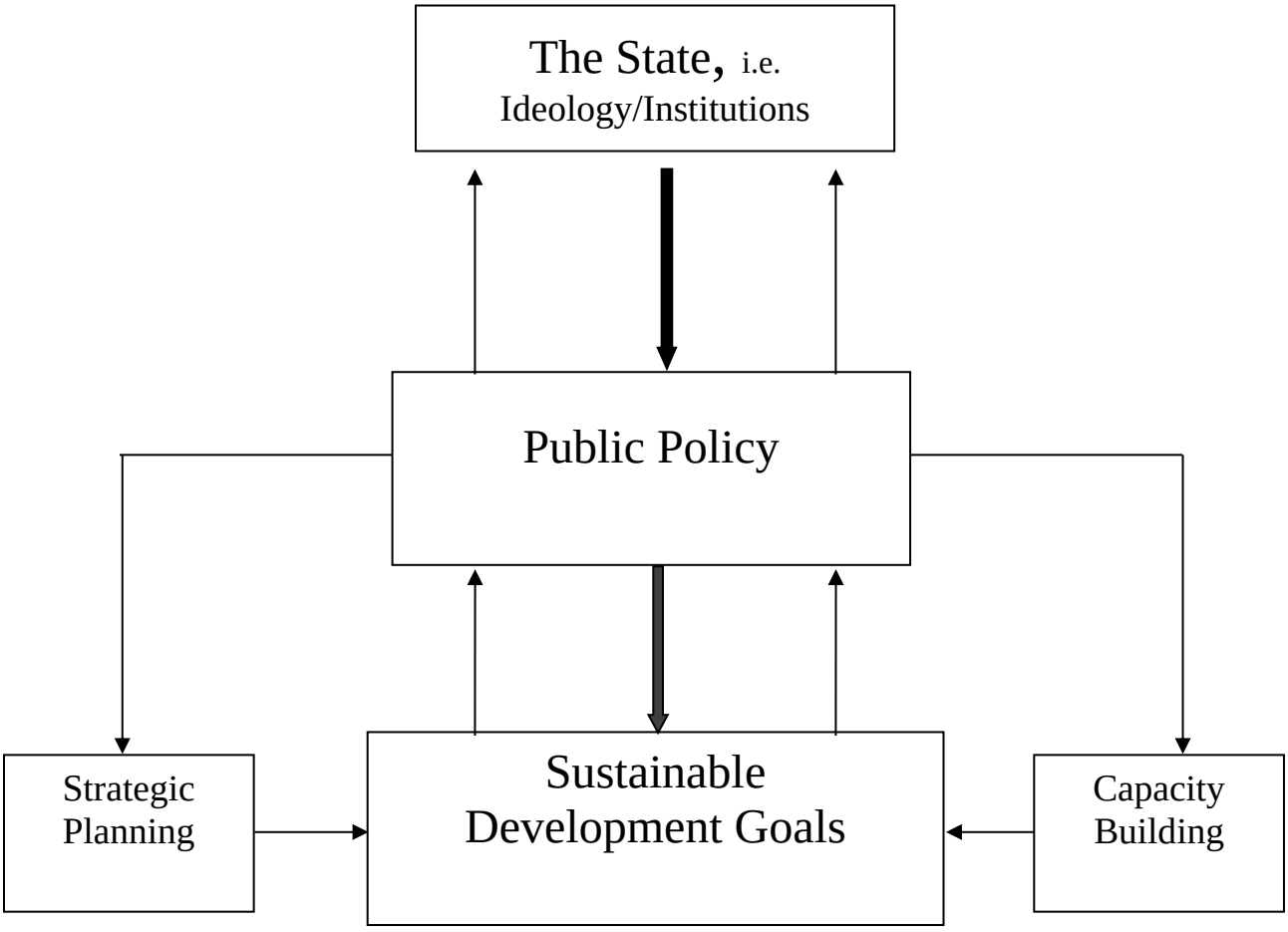

Fig. 1. The State and the flow of public Policy for sustainable Development Goals. (Authors creative idea)

The African State and the Challenge of Sustainable Development

The conditions of the African State

The study of the polity includes the social decision-making process which is a process that has an impact on every member of society. (McAuley, 2003). The government is a major player in the decision-making process and in performing this decision-making role, the government acts on behalf of the state, the state that is today, the most crucial political actor, indeed, the powerhouse of the society.

There may be diverse definitions perspectives or classifications of the idea of the state, but in all modern societies, the defining characteristic of the state is that it has power over every member of society. And, in any given society, the power is universal, the power that is responsible for all the decisions that are taken by organs of the state, particularly the government. (Belov, 1986). Thus, the African State needs some elaboration in order to understand how it will formulate and implement the policy of sustainable development goals. This is precisely because the nature of the state, and the institutions through which legitimate

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power is exercised and enforced are central to policy formulation and implementation in any society. (Smith, 2009). Today, the conditions in Africa provide some reasons why an analysis of the African State is necessary for an understanding of the performance of policy formulation and implementation on the continent. Hence, some attention needs to be given to the African conditions with regard to the nature of the African State, while discussing the policy of sustainable development, in particular, the 17 SDGs. It is, therefore, not out of place to see the African State in a peculiar way because the modern African State is an imposition of colonialism and because it did not evolve gradually as capitalism progressed, as was the case in Europe, it now possesses some unique characteristics.

As earlier noted, the modern state is a creation of capitalism when the capitalist class realised the need to have an institution for control and dominance. That was because capitalism had torn the society apart with its creation of irreconcilable contradictions between antagonistic classes, because of a lack of unity of interests. (Belov, 1986). However, in pre-colonial Africa, there was no capitalism but slavery and feudalism and therefore there were no capitalist social classes or capitalist institutions that represent the interest of capital, as a result, the modern state did not exist in Africa. Consequently, one of the uniqueness of the post-independent African State was the evolution of a political class that was created by colonialism but with its own trajectory of development based on the unleashing of capitalist forces. Thus, colonialism created capitalism in Africa when there was no capitalist class. It also created capitalist political institutions when there was no capitalist state. (Fadakinte, 2021). It is, therefore, unfortunate that the African post-colonial state has taken on more elements of the capitalist colonial state without a well-rooted capitalist ethos in African Society. Thus, the legacy of the colonial state is the weak vertical and horizontal integration of the African State, emphasizing the dominance of brute/raw power rather than rational authority and relying on weak and low-level government. (Olowu, 1994). The reason for this weak condition of the state is that at independence, the dominant class in Africa got political power but without economic power because economic power was still with the metropolitan capitalists in Europe, as they dominated the economy. Consequently, at independence, those who were given political power did not have economic power. The result was that the dominant class, which became fragmented during decolonization, embarked on a bitter struggle for resources, political and economic, with the aim of taking control of state power and consolidating it. (Fadakinte, 2020). In the process, the attitudes of the dominant class toward politics became violent and any faction that controls state power becomes ruthless, which explains the fragility of the state. As a result, the African society with its internal structures and the inherited colonial institutions became weak making the state unproductive. Consequently, the state became crisis-ridden by being enmeshed in a factional struggle for power and it became inefficient and unproductive due to a lack of clarity of public policies, because, in Africa, public policies are devoid of meaningful and relevant ideology.

Furthermore, because of the weakness of the African state, the Society became strong which makes private interests riddle the state and the ordinary citizens ignore state directives. (Rapley, 1996). The African state is, therefore, not strong enough to be effective and again, it is short of rational and legitimate power and also, it is deprived of bureaucratic resources to make it function efficiently. As a result, the state is quite distant from the people, which is why it is difficult for it to successfully formulate and implement policies. (Rapley, 1996). In addition, the inherited well-organized bureaucracy, from European colonizers, now lacks the normal

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bureaucratic power and legitimacy and most frequently has to work with inadequate information. (Smith, 2009).

However, it is inevitable for the African state to be insipient and crisis-ridden because the character of the dominant class defines the nature of the state and the values of the dominant class also determine the form of public policy.

Consequently, (Smith, 2009) has identified four characteristics as the defining nature of the African State. These are,

- The legacy of colonialism continues to influence the African State.
- The African State stands between being one of a society-centred and one of a state-centred institution.
- The impact of the forces of globalisation now renders the African State weak with regard to political power.
- The African State is with perpetual political instability.

And (Anderson, Hey, Peterson, Toops, and Stevens, 2008), argue that;

- Unstable governments and civil conflicts have taken a heavy toll on African people that today Africa is home to seven of the ten states that are most susceptible to political and economic collapse.
- Africa is today less connected to the global economy than any other continent. For example, in twenty years, that is between 1980 and 2000, Africa received more than $300 billion but economic growth in much of the region declined.
- African governments continue to incur greater and greater debt to finance their projects.
- Today, Africa produces less food than thirty to forty years ago. And about 75% of the African population makes their living off the land while in America the percentage is less than 2%.

The Challenge of Sustainable Development

There is no doubt that the idea of sustainable development has some challenges in Africa, and the main challenge is the state which is responsible for articulating a policy for the achievement of the sustainable development objectives. However, with the description of the African state, it will not be too difficult to understand why and how the 17 SDGs cannot be met in 2030 as proposed.

With the African state in such a condition of flux and the society so underdeveloped, meeting the development goals will certainly be a mirage. For example, Africa ranks the least among the six continents of the world in the following areas

- Education and literacy level
- Poverty

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- Life expectancy
- Debt portfolio
- Development index

CONCLUSION

If sustainable development is about laying emphasis on the links between development and environmental problems and promoting political and economic change, then Africa is far from being able to achieve any of the 17 SDGs, within the fifteen-year time frame, from 2015 to 2030. This is because the primary reason why sustainable development became an issue was to raise some concerns about the process of economic growth and development that is accompanied by massive industrialization and the effects on the environment. (Smith and Warr, 1999). Therefore, going by the current situation and the debilitating conditions of African society, it is doubtful if Africa has the peace, at the moment, to study the concept of sustainable development in order to understand the extent to which all the issues raised in the 17SDs affect the continent (Smith and Warr, 1999). In any case, Africa is far from possessing an industrialized economy that will engender serious concerns about the effects of industrialization on the environment. However, for the current pitiable conditions of Africa, being a continent in a debt trap and unable to adequately feed her teeming population, this is the time to start bearing in mind the idea of sustainable development, so as to be able to take care of the environment and address all the identified concerns while planning for development.

The 17 SDGs, perhaps, summarize the African conditions, from poverty, hunger, and poor health to weak institutions and it is doubtful, except by some magical intervention, for Africa to solve the problems in 15 years, as planned by the UNDP in September 2015. Fig. 2 below explains the pitiable conditions of the African state that make meaningful policy difficult to formulate and which explains why sustainable development, with its objectives, being policy issues are currently far beyond the capacity of African states.

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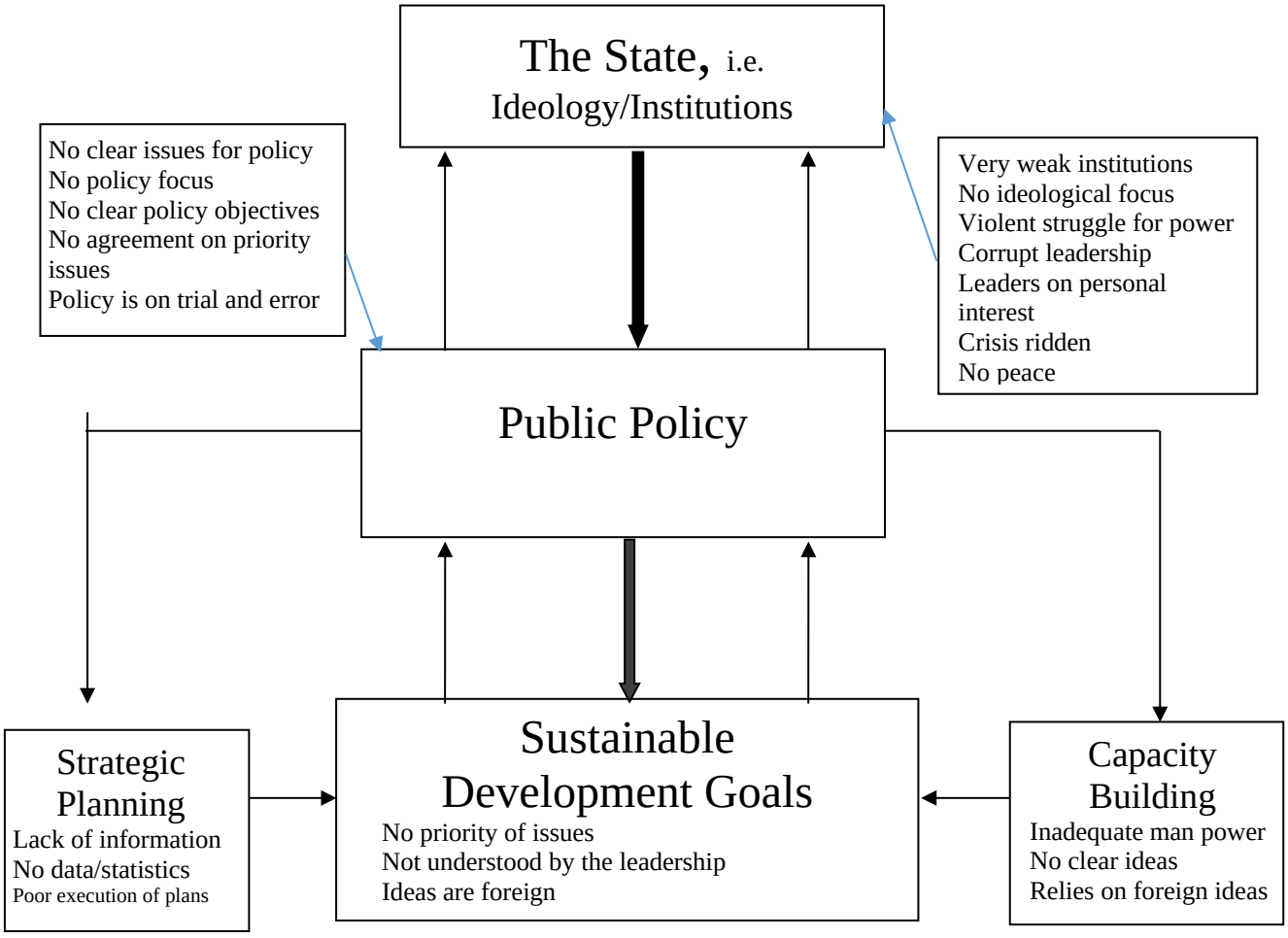

Fig. 2. The conditions of the African State and Public Policy for Sustainable Development Goals. (Authors creative idea)

Finally, what then is to be done? We need to understand how colonialism and its legacies created foreign institutions, particularly the state, which is now the main challenge to development in Africa. The imposition of the European capitalist model of state is yet to emerge and consolidate its powers and unfortunately, the process of its emergence is now fraught with the violent struggle by factional political leaders.

Second, the state has earlier been identified as the powerhouse of society, making it a crucial institution and a critical political actor in the development process. But because the African state is crisis-ridden, it does not have the peace to formulate meaningful policy on a well-defined ideology to promote development and aim at sustainable development.

Lastly, for now, we cannot be talking about sustainable development in Africa rather, we should be talking about how to develop a cohesive and responsible dominant class to enable them to produce a ruling class, a class that will be in control of politics and also control and

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manage the economy in the interest of all and not a corrupt and parochial gangs and brigands, who parade themselves as leaders while holding on to power for their selfish purposes.

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RURAL LIVELIHOODS AND FOOD INSECURITY AMONG FARMING HOUSEHOLDS IN SOUTHWESTERN NIGERIA

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ABSTRACT: *Rural livelihoods have been the subject of empirical analysis in development studies because they play important roles in mitigating Food Insecurity (FI). In Nigeria, the incidence of FI is higher among the rural populace, particularly the peasant farming households, than urban households. Previous studies have linked aggregate measure of rural livelihoods to FI with little attention to contributions of specific components to FI. Hence, the influence of rural livelihoods on FI status of farming households was investigated. Primary data were collected from 400 farming households in Osun and Ekiti states of Southwestern Nigeria using semi-structured questionnaire. The result shows that age of household heads was 51.9±11.4 years, while household size was 8±2.9 persons. Households that were Core Food-insecure (CFI), Moderately Food-insecure (MFI) and Non Food-insecure (NFI) were 4.38%, 35.89% and 59.73%, respectively. The probability of being NFI was increased by age (0.0115), Being Married-BM (0.1073), Household Size-HS (0.0166), Post Primary Education-PPE (0.1090), Access to Irrigation-AI (0.1376), rain forest zone (0.1417), and Financial Asset-FA (0.1630), while extension services (-0.0040) and Access to National Grid-ANG (-0.1620) reduced it. Extension services (0.0030), farming experience-FE (0.0052), and ANG (0.1202) increased the probability of being MFI, while age (-0.0085), BM (-0.0706), PPE (-0.0809), HS (-0.0123), AI (-0.1020) and rain-forest zone (-0.1051) reduced it. Extension services (0.0011), FE (0.0018), and ANG (0.0419) increased the probability of being CFI, while age (-0.0030), BM (-0.0277), PPE (-0.0282), HS (-0.0043), AI (-0.0356), rain-forest zone (-0.0366) and FA (-0.4210) reduced it. On-farm rural livelihood relative to combined on-farm with off-farm and non-farm, reduced food insecurity among farming households in Southwestern Nigeria.*

KEYWORDS: Rural Livelihoods, Food-Insecurity, Livelihoods' Assets, Food Consumption Scores

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INTRODUCTION

Background to the Study

Food insecurity is a problem affecting global development efforts for a number of decades. It is often an indication of poverty and it is the most widely used measure of food deprivation. It implies that, sustained access to save, sufficient and nutritious food is restricted by inadequate income or resources as at when needed (FAO, *et al.,* 2019). In 2018, the population of the undernourished people worldwide was about 821million with 29% living in sub-Saharan Africa, while over 2 billion suffering from one or more micronutrient deficiencies (CDC, 2020). Poverty, which is a permanent or temporary state of deprivation caused by inadequate entitlements including income, wealth and access to adequate food is pervasive in Nigeria (World Bank, 2019). In 2018, the World Poverty Clock reported that Nigeria is the capital of the world's poverty suggesting a worst scenario of undernourishment in sub-Saharan Africa.

Food insecurity occurs when individuals or households are faced with limited physical, social or economic access to safe, sufficient and nutritious food for healthy life (Kakwani and Son, 2017). It restricts people's ability to acquire nutritionally adequate and save food in a way that is socially acceptable (USDA, 2019). The physical health and productive life impairment are a consequence of individual or household's inability to have secured access to nutritionally sufficient food (Jones *et al.,* 2013). Food insecurity is a threat to social-political order. The 2007-2008 food riot is a fallout from food price crisis, thus recognizing the fundamental role of food access in social cohesion. Thus, an individual is entitled to improved quality of life that takes into consideration the adequate health and wellbeing of individuals and this right is enshrined in Article 25 of the Universal Declaration of Human rights of 1948. Food insecurity status, which can either be transitory if an individual or household has temporary shortfall of food consumption requirements or chronic if a long term or permanent condition of inadequate food consumption requirement prevails. It often changes over time subject to seasonality or as a result of stochastic shocks including weather events, death or social conflict (FAO *et al.,* 2019).

A major factor with high potential to solve food insecurity issue is the livelihood of the people. It comprises of different assets and activities that enable individuals or households to achieve their means of living (ACF, 2010). Report shows that, the rural area of the developing world is characterized by widespread hunger and poverty, where family farming and smallholder agriculture including animal husbandry, fishing and non-farm participation are the common livelihoods. Thus, rural livelihoods comprise of mainly agriculture with a segment of the population diversifying into non-farm activities in order to pursue their livelihood goals (Davies *et al.,* 2010).

Rising from the problems associated with rural agriculture which include depleting soil fertility, poor infrastructure, weather and climatic vulnerability among others, rural households in developing countries including Nigeria are forced by necessity to deploy strategies such as agricultural intensification, livelihood diversification and migration in attempts to secure their livelihoods (Otaha, 2013; Jemal and Kim, 2014). Diversification is a broad component of rural livelihoods existing at varying levels of the rural economy. It could be viewed as adaptation technique or risk management for agrarian households. Rural households in Nigeria whose livelihoods depend largely on subsistence farming combine or diversify into one or more sources of non-farm income with the aim of achieving positive livelihood outcome (Kassie,

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2016). Studies have shown that farming activities on average account for only 40-60% of the livelihoods pursued in South Asia and sub-Saharan Africa (Hilson, 2016). Livelihood and food insecurity are two concepts that are closely linked, while livelihood encompasses the capabilities, assets and activities required for a means of living, food insecurity is just one undesirable outcome resulting from inability of livelihood to ensure secured access to adequate and nutritious food.

Statement of the Problem

Statistics show consistent increase in national production of major food crops in Nigeria for over five years (CBN, 2016). In 2016, the Central Bank of Nigeria also reported increase in crop and livestock production with about 3.5% and 5.99% respectively. According to Olomola, (2015), the staple food production of rice, sorghum, cassava and maize increased by 1.3million MT, 13000MT, 600,000MT and 6.28million MT respectively between 2012 and 2014. Overall, the national food supplies rose by over 20 million MT between 2012 and 2015. In spite of these increases in national food production as well as the rising food imports bill averaged ₦1.4 trillion between 2011 and 2015 (NBS, 2015), the food insecurity situation in Nigeria is worsening with about 7.1 million people currently at the risk of being faced with chronic food poverty and in need of emergency safety nets and social protection (FAO, 2017). Consequently, the affected population suffers from the problem of undernutrition and inadequate access to nutritious and sufficient food (FAO, 2018).

Statistics show that, the annual population growth rates in Nigeria between 2011 and 2016 averaged 2.7%, while the annual growth rate of agriculture during the same period averaged 4.1% (Olomola, 2018), suggesting that the real issue with food insecurity in Nigeria are concerned with the economic access and per capita real income of households. This is because about two-third of households in the south of the Sahara including Nigeria engage in vulnerable employment in Agriculture (FAO *et al.,* 2015). In the face of persistent and sharp increase in food prices, low demand for wage labor, unemployment, sickness or death of bread-winner, existence of adequate aggregate food supplies does not guarantee food security at the household level (Kakwani and Son, 2017).

Available evidence shows that the population of undernourished in Nigeria increased from 4.7 million (5.9% of the population) in 2008 to 12.9 million (7% of the population) in 2016 indicating an endemic increase in food insecurity (IFPRI-GHI 2016; Olomola, 2018). When compared to urban households, food insecurity is more prevalent among the agrarian people particularly the peasant farming households in Nigeria (Fawehinmi and Adeniyi, 2014) This is because rural agriculture is characterized by drought, unpredicted rainfall pattern, land fragmentation, low level of productivity and high level of peasant farming (Jirstrom *et al.*, 2011).

Several efforts have been made in the past by successive administrations to address food insecurity through the creation of special programmes and projects. These include: National Accelerated Food Production Progamme, (NAFPP) (1973); National Special Programme on Food Security, (NSPFS) (2008); National Food Crisis Response Programme (NFCRP); Food Security Thematic Group (FSTG) (2009). Seven Points Agenda with emphasis on Food Security (2009), Agricultural Transformation Agenda (2011-2015) and more recently Agricultural Promotion Policy (2016-2020). These efforts were met with little success as Nigeria is ranked 103th out of 119 countries in the global hunger scores (GHI, 2018).

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Sabates-Wheeler *et al.* (2012); Asogwa and Umeh, (2014) attributed the problem of food insecurity to low productivity of the Nigerian agriculture resulting from inadequate technology that characterize the sector. While the need to increase national food supply through productivity initiatives is key to tackling food insecurity problem, diversification of income sources has equally been recognized as a strategy for poverty reduction as well as reducing the extent of vulnerability (Khartum and Roy, 2012). The relevant questions that this study attempted to answer include: To what extent do farming households have access to livelihoods' assets? What choices of livelihoods were pursued by farming households in the study area? To what extent do farming households have access to nutritious food? What influence do rural livelihoods have on food insecurity status of farming households in Southwestern Nigeria?

Objectives of the study

The main objective of this study was to determine the influence of rural livelihoods on food insecurity status of farming households in Southwestern, Nigeria. The specific objectives of the study attempted to:

i. Assess the extent of farming households' access to livelihood assets.

ii. Identify the choice of rural livelihoods pursued by farming households

iii. Profile food insecurity status of farming households in the study area.

iv. Determine the influence of rural livelihoods on food insecurity status of farming households in Southwestern Nigeria.

LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Literature Review

A paradigm shift in recent development literature views food insecurity as a livelihoods' failure to ensure access to adequate food at the household rather than agricultural failure to produce sufficient food at the national level (Nwalie, 2017). Although, appropriate agricultural policies might show a reported increase in national food production, food insecurity may be persisting at the household due to inefficient agricultural food system or unfavorable macroeconomic indices such as price fluctuation, unemployment, high foreign exchange rate and inflation. Hence, the need to examine the extent to which the choice of rural livelihoods affects household's economic access to food is critical to solving the food insecurity problem. Furthermore, data obtained through household and food consumption survey, upon which this study is based, are often the most preferred sources of food consumption estimates for most analysts, because they are found to be more reliable and provide accurate information than nationally aggregated data on Food Balance Sheet (Kakwani and Son, 2017).

Previous studies (Ayantoye *et. al.*, 2011; Asogwa and Umeh, 2012; Dzanya *et. al.*, 2015) on food insecurity adopted the cost of calorie index proposed by Greer and Thorbecke (1986) as applied by FAO (2003) to estimate food insecurity threshold. However, maintaining stable health condition also requires adequate intake of calories, protein, vitamins and minerals. Cost of calorie function which they derived exclusively from the inadequacy of calorie requirement does not take into consideration the issue of under-nutrition or malnutrition or quantities of the

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nutrients. Oni and Fashogbon, (2013); Asa and Achibong, (2016); Mamman *et.al.* (2016) used food poverty measure proposed by Foster, Greer and Thorbecke (1984) to estimate food insecurity line. But this measure provides estimates of monetary value of food rather than adequacy (or otherwise) of dietary requirements for healthy life. The exceptions to these studies are the studies conducted in Ghana by Mensah (2014) and collaborative 'Report of Food Security Sector Humanitarian Agencies (2015) conducted in the North East, Nigeria. There is a dearth of information or gap in knowledge that this study intended to fill using the Food Consumption Scores (FCS) to assess food insecurity status. In using this measure, the food quantity was not taken into consideration. But it was reported to be positively and significantly correlated with kilocalories consumed per capita per day, asset indices and total monthly household expenditure (Coates *et al.,* 2007).

The methodological debate on livelihood studies reveals that some studies (Roy, 2012; Awoniyi and Salman, 2014) quantified rural livelihoods using the aggregate indexing approach derived from the share of different income sources available to farm households. Although, this approach is widely favoured in the literature for its simplicity and objectivity, the possibility of identifying the specific component that provides higher expected income with lower risk of food insecurity is problematic as the sub-components are averaged into a single index score. More so, relying on estimates obtained from direct use of income or income share could be misleading due to the random nature of income which has the intrinsic to make significant fluctuations in perceived income sources over time. (Barrett *et al.,* 2001). Even if income is not stochastic, measuring income for some activities including farming particularly in developing countries is difficult.

Further, Oni and Fashogbon, (2013); David, (2013) quantified rural livelihoods using the main or single activity variable and adopted the sectorial classification commonly used in national accounting systems to link the household's main activity to corresponding outcome. However, rural livelihoods cannot be analysed based on a single activity component as rural households are often engaged in combinations of activities (Barrett *et al.,* 2001). Mensah, (2014) and Mohammed, (2014) quantified rural livelihoods using a checklists of livelihood activities pursued and stratified households in to 'diversified' (i.e. on-farm + non-farm activities) and non-diversified (on-farm activity only) using Barrett *et al.* (2001) sectorial classification. Although this approach is known for its computational simplicity, the authors failed to empirically account for relative contributions of other livelihood activities to food insecurity. For example, some activities with low entry barriers such as environmental gathering cannot be classified as on-farm or non-farm. Classifying them into non-farm activity could yield a misleading result in view of overwhelming empirical evidence of negative impact of non-farm income strategy on food insecurity.

This study deviates from the previous approaches as it adopted the concept of livelihood strategy to capture the various activities or combinations of livelihood activities pursued by farming households using the income portfolio analysis and activity variables to cluster farming households into mutually exclusive choices of rural livelihoods as the basis for proffering solution to food insecurity problem. Understanding asset endowment at the disposal of rural households and also the choice(s) of livelihoods pursued towards securing their livelihoods could provide useful insights for policy makers on the choice of appropriate and context-specific livelihood intervention programmes that can sustainably mitigate the problem of food insecurity.

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Theoretical Framework: Theory of Random Utility

The intrinsic motives driving household's choice of livelihoods are to maximise utility through predicted earnings from undertaking a specific livelihood (Dearcon and Krishnan, 1996). The random utility is a framework used to analyse a household's choice of livelihoods. According to the theory, utility is an intangible construct laden with sense of feelings by individuals or households but cannot be directly observed (Phaneuf, 2005). Further, it premised that this unobservable utility may be split into two parts: systematic or representational utility (V) and random or unexpected utility (ε_i). This random component emerges due to the unpredictability of the individuals' choices as well as the fact that the characteristics do not cover all of the preferences. Thus, the total utility derived by the i_{th} household from engaging in a particular livelihood can be explicitly stated as a linear combination of two components: (i) a deterministic part, V_{ia}, that accounts for the explained components and (ii) stochastic error term that accounts for unexplained components such as measurement errors.

$$U_{ia} = V_{ia} + \varepsilon_{ia} \quad \text{..... (1)}$$

Given that V_{ia} is a deterministic component and ε_{ia} constitutes the "white noise" component (Thurstone, 1997). The assumption is that, allocation of assets to each activity or group of activities is expected to maximise household's utility derived through the entitlement set. Assets would be allocated by a household such that the value of marginal product across the set of activities are equal or would be completely allocated to a single activity that has higher return. As a result, the likelihood that the utility of a livelihood set '*a*,' is greater than the maximum utility of the alternative set *i* is expressed as follow:

$$P(a) = P\left[U_{ia} > \text{Max}\, U_{ji}\right] = P\left[V_{ia} + \varepsilon_i > \text{Max}\, V_{ji} + \varepsilon_j\right] j \neq a \text{..... (2)}$$

The assumption is that, the utility function is a linear combinations in parameters X_i characteristics of the farming household's head, those of the alternative livelihood set 'a' viewed by i_{th} household and a random or unexpected component.

$$U_{ia} = \beta^{\iota} X_{ia} + \varepsilon_{ia} \text{..... (3)}$$

Where β^{ι} is a vector of unknown parameters and X_{ia} is a vector of observed attributes of the household head as well as livelihoods' choice and ε_{ia} is the error term.

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METHODOLOGY

Study Area

This study was conducted in Southwestern Nigeria. It is one of the six geo-political zones in the country. The South-west consists of six states namely Lagos, Ogun, Oyo, Osun, Ondo and Ekiti State. The zone lies between latitude 600 211ˡ and 800 371ˡ North (Faleyimu *et al.,* 2010) and longitude 200 311ˡ and 600 001ˡ East. It shares border with Kogi and Kwara states in the northern part and with Atlantic Ocean in the southern part, Edo and Delta states in the eastern part, while in the western part by the Republic of Benin.

The Southwest has a land area of about 114,271 square kilometres with total population of 27,581,992 (NPC, 2006). The zone houses the Yoruba ethnic group. The zone has a distinct feature of tropical climate marked with dry season between November and March and a wet season between April and October. The average distribution of annual rainfall is 1480mm and a mean monthly temperature range of 18^0C-24^0 C and 30^0C-35^0C during the rainy and dry seasons respectively. The vegetation cover of the southwestern zone consists of fresh water and mangrove. The crops such as rice, maize, sorghum, cowpea, groundnut, yam, potato, cassava, and soya bean are predominantly grown in the area. The people of the zone also practice fishing, poultry, livestock husbandry and non-farm activities such as trading and wage employment.

Sampling Procedure:

Multi-stage sampling procedure was used for this study. In the first stage, Osun and Ekiti states were purposively selected from the six states of the Southwestern Nigeria because the two states have the highest poverty ranking and by extension food insecurity (NBS, 2016). The second stage entailed random selection of two out of the three ADP zones in each of the two states making a total of four ADP zones. ADP is known to coordinate agricultural activities in Nigeria. ADP is administratively structured into zones, blocks and cells. Zone has at least four or five Local Government Areas or blocks, while cell consists of numerous villages that are situated in the block. In the third stage, there was a random selection of seven and four blocks respectively from the selected ADP zones of Osun and Ekiti states, making a total of eleven blocks (11 LGAs) in the selected two states. In the last stage, four hundred (400) farming households were randomly chosen from the two states proportionate to the size of the selected villages. The proportionate factor used was given as follows:

$$m_i = \frac{M_i}{M} \times 400 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

Where m_i = the number of farming households to be selected from i_{th}village

M_i= total number of households in i_{th} village

M = total number of households in all the selected 46 villages

400 = desired number of households for the survey

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However, only three hundred and sixty-five (365) copies of questionnaire with valid information were used in the analysis.

Methods of Data Analysis

A number of analytical techniques were presented in this section in order to operationalize the study objectives. These include the descriptive statistics, principal component analysis, income portfolio analysis, food consumption scores, instrumental variable (IV) ordered probit as well as ordered probit model.

Principal Component Analysis (PCA)

Following Moser and Felton,(2007) and the works of Jemal and Kim (2015), Principal Component Analysis (PCA) was used to derive a composite score from household's endowment of various binary assets ownership variables as well as assets variables measured on interval and ordinal scales. The eigenvectors of the covariance matrix resulting from maximum likelihood estimation produces the principal components of the data set. The first principal component was used to create the asset score because it contributes the maximum variation to the original data sets.

The intuition in using this procedure is that the livelihoods' asset was considered a latent variable that cannot be observed in the survey. The manifestation of this latent variable was observed only through access to five different categories of livelihoods' assets that include Natural, Physical, Human, Financial and Social assets that are also latent. The PCA-based model of livelihoods' assets is specified as follows:

$$A.S_{l_i} = \alpha' NA_i + \beta' PA_i + \gamma' FA_i + \delta' HA_i + \lambda' SA_i \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (5)$$

$A.S_{l_i}$= Livelihood Asset-score for i^{th} household, NA_i = Natural asset; PA_i= Physical asset; FA_i= Financial asset; HA_i= Human asset; $S.A_i$= Social capital; $\alpha, \beta, \gamma, \delta,$ and λ are the eigenvectors of the covariance matrix for Natural, Physical, Financial, Human and Social assets respectively. In using the PCA, the idea was to take these j^{th} asset indicator variables for each category of asset and find their combinations to produce indices Z_1, Z_2 …….Z_j, that are not correlated and whose variances decrease from first to the last. The Z_i produced was the principal components given by:

$$Z_j = b_{j1}S_1 + b_{j2}S_2 + b_{j3}S_3 + \ldots + b_{jj}S_J \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (6)$$

Where $b_j^1 = [b_{1j} \ldots b_{jj}]$ are vectors of the scoring factors or weights and $S_1 \ldots\ldots S_j$ are vectors of indicator variables for j^{th} category of asset. Following Scoones, (1998), the indicator variables used for constructing composite score for each of the asset category were given as follow:

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N. A_i: **Access to Natural asset**

N_1 = Farm size (ha)

N_2 = Access to forest resources/products (1= yes, 0 otherwise)

N_3 = Access to irrigation (1= yes, 0 otherwise)

P. A_i: **Access to Physical asset**

P_1 = House ownership (1=yes, 0 otherwise)

P_2 = Ownership of vehicle (1=yes, 0 otherwise)

P_3 = Access to the tarmac road (1=yes, 0 otherwise)

P_4 = Access to the national grid (1=yes, 0 otherwise)

P_5 = Distance to the market (km)

F. A_i: **Access to Financial asset**

F_1 = Remittances received (₦)

F_2 = Microcredit received (₦)

F_3 = Number of livestock owned (Tropical livestock units, TLU)

F_4 = Ownership of jewelries (1=yes, 0 otherwise)

H. A_i: **Access to Human asset**

H_1 = Labor availability (economically non-active/active household members)

H_2 = Distance to the nearest health care centers (km)

H_3 = Health status (Normal=1, 0 otherwise)

H_3 = Years of formal education of household head

S. A_i: **Access to and/or ownership of Social assets**

S_1 = Membership of social organization (1=yes, 0 otherwise)

S_2 = Decision making in social organization (1= yes, 0 otherwise)

S_2 = Share of income from remittances (₦)

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A 2-stage factor analysis was used to estimate a composite score of livelihoods' assets for each household. In the first stage, a composite asset score was estimated separately for each category of livelihoods' asset using the iteration technique of principal factor. In the second stage, an aggregate score of livelihoods' assets was computed from the previously (first stage) estimated interacting variables. Formular to compute PCA-based asset score was given as follows:

$$A.S_{lj} = \frac{\sum F_i(X_{ji} - X)}{S_i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots (7)$$

Where $A.S_j$ is the value of the j_{th}household's asset obtained using the PCA technique, F_i = scoring factor of the weight for the i_{th} variable in the PCA model, X_{ji} = j^{th} household value for the i_{th} variable, X and S_i are the mean and standard deviation respectively for the i_{th} variable.

In the first stage, the mean value of PCA-based composite asset score for each category of asset was used to classify households into three different levels of access to livelihoods' assets given as 'high, moderate or low' level. Households with scores above two-third (2/3) of mean asset score were ranked "high", while those with scores above the one-third (1/3) but less or equal two-third (2/3) of the mean asset score were ranked "moderate". Those with scores less than or equal to one-third (1/3) of the mean asset score were ranked low. However, in the second stage of the analysis, this classification was collapsed into only two categories (Low/High) due to the convergence in the data set. Households with composite score that exceeds or equal to the population mean score were ranked "high" while those with score less than the population mean were ranked "low" in terms of access to livelihood assets.

Income Portfolio Analysis

Income Portfolio Analysis was used to identify the choice of rural livelihoods pursued by farming households. This involved identifying people by income proportion received from various sectors of the rural economy classified by Ellis, (1998) and Barrett *et al.* (2001), as follow:

A. Farm income: This is the income type obtained from the use of land inherited, purchased, rented or accessed by share tenancy for agricultural activities including crop, livestock, fishery and forestry.

B. Off-farm income: This is the type of income or wage earned from the use of own labour hired in other farms within the context of Agriculture.

C. Non-farm income: This includes earnings from non-agricultural sectors such as non-farm employment, transfer income, rents received, rural wage and earnings from distant relations to an agrarian household (Ellis, 2000).

From the foregoing classification and following the works of Kassie *et al.* (2017), farming households were identified and grouped into four mutually exclusive livelihoods' choices as: on-farm (agriculture only); On-farm with off-farm (ONF-OF), on-farm with non-farm (ONF-NF) and on-farm, off-farm and non-farm (ONF-OF-NF) choice of rural livelihoods (Aboud *et al.,* 2001).

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Food Consumption Scores (FCS)

Following the works of Mensah (2014) and collaborative "Report of Food Security Sector Humanitarian Agencies (2015), Food Consumption Scores (FCS) was used because it is shown to be a valid proxy for measuring adequacy or otherwise of dietary requirements including micronutrients using data on household's consumption of different food groups (FANTA, 2006).

Food Consumption Scores (FCS) was estimated by asking the caregiver in a household about the frequency of consumption of each of the eight (8) food groups using 7-day recall. The food groups are: staples-maize, rice, sorghum, yam, cassava, potatoes and millet), pulses -legumes, nuts and seeds- vegetables, fruits, meat and fish, dairy products, sugar and oil. The assigned weights for each food group are: meat, milk and fish = 4; pulses = 3; staples =2; vegetables and fruits =1, sugar and oil =0.5 (WFP, 2007). The frequency of each of the food group consumed was multiplied by a predefined weight and the resulting values are summed to obtain the food consumption score as follow:

$$FCS_i = \sum_{fg_{h=1}}^{n=8} w_{fg} f_{fg} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$

Where FCS_i is the food consumption score obtained for i_{th} household; w_{fg}= weight of h_{th} food group consumed, f_{fg}= frequency of h_{th} food group consumed and n = total number of food groups. Based on these scores, three different cut-off categories representing food insecurity status of individual households were obtained as follow: "poor" conceptualized as core food insecure ($y^*\leq 21$), "borderline" conceptualized as moderately food insecure ($21 < y^* \leq 35$) and "acceptable" conceptualized as non-food insecure or food secure ($y^*>35$) with respect to frequency of food groups (dietary diversity) consumed.

Instrumental Variable (IV) Ordered Probit Model

The instrumental variable (IV) ordered probit model as proposed by Amemiya (1978) and Newey (1987) and adopted by Maitra and Rao, (2014) was used to analyse the influence of rural livelihoods on food insecurity status of farming households. The choice of this model was premised on its suitability for estimating bi-causal or jointly dependent relationship among economic variables (Greene, 2012). Furthermore, the ordered probit regression is suitable for estimating model with ordinal outcome. Thus, Y which is a proxy variable for the latent Y^* is a linear function of selected covariates, x_I, plus a normally distributed error term.

$$Y_i^* = x_i\beta + \varepsilon_i \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots..... \quad (9)$$

For i_{th} rural household, where $\mu_0 = 0$ and u_j=1 denotes the two food insecurity categories through which the three observed Y values were determined as follows:

$$Y_i^* = Y_i = \begin{cases} 0 & \text{if } y_i^* \leq \mu_0, \ (\text{None} - \text{food insecure}) \\ 1 & \text{if } \mu_0 < y_i^* \leq \mu_1 \ (\text{moderately food} - \text{insecure}) \\ 2 & \text{if } \mu_1 < y_i^* \leq \mu_2 \quad (\text{Core} - \text{food insecure}) \end{cases}$$

The full specification of the ordered probit model is given as follow:

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$$Y_i^* = Y_i = \beta_1 X_1 + \beta_2 X_2 + . + \beta_{14} X_{14} + \beta_{15} X_{15} + \beta_{16} X_{16} + \beta_{17} X_{17} + \beta_{18} X_{18} + \varepsilon_{1i} \quad (10) \text{ Model 1}$$

$$Y_i^* = Y_i = \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_{13} X_{13i} + \beta_{14} X_{14} + \varepsilon_{1i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (11) \text{ Model 2}$$

Where Y^* is a row vector of latent, unobservable food consumption scores that determine the observed, Y_i ordinal outcomes of 2, 1 and 0 for core-food insecure ($y^* \leq 21$), moderately food insecure ($21 < y^* \leq 35$) and none-food insecure ($y^* > 35$) respectively; X's denote the vector of explanatory variables; β is the associated vector of unknown parameters and ε is an independently distributed error term ($\varepsilon_i \sim$ iid: $0, \sigma^2$). The explanatory variables following the works of Yishak *et al.* (2014); Maitra and Rao (2014) and Mensah, (2014).

Demographic and Socio-economic

X_{1i} = Age of the household head (years)

X_{2i} = Gender of the household head (1=male, 0 otherwise)

X_{3i} = Marital status of the household head, (1= married; 0 otherwise)

X_{4i} = Post primary education (1= post primary education, 0 otherwise)

X_{5i} = Household size

X_{6i} = Dependent ratio (non-working /working members of household)

Economic (Production/Exchange)

X_{7i} = Farming experience of Household head (years)

X_{8i} = Primary occupation of Household head (1= farming, 0 otherwise)

X_{9i} = Access to irrigation (1= yes, 0 otherwise)

X_{10i} = Agro-ecological zone (1= Rain forest, 0 otherwise)

X_{11i} = Rural livelihoods (1= on-farm, 2= on- farm + off-farm,
3= on-farm+ non-farm, 4= on-farm +off-farm+ non-farm).

Institutional/Resilience Influence

X_{12i} = Frequency of contacts with extension agents in a year

X_{13i} = Access to National Grid (electricity)

X_{14i} = Aggregate Asset score (PCA-based)

X_{15i} = Natural Asset score (PCA-based)

X_{16i} = Physical Asset score (PCA-based)

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X_{17i} = Human Asset score (PCA-based)

X_{18i} = Financial Asset score (PCA-based)

X_{19i} = Social Asset score (PCA-based)

Endogeneity Issue in Food Insecurity Model

Supposing the dependent variable Y^* and independent variable X_{14i} in equation (11) were assumed to be jointly determined such that asset variable, X_{14i} can also be influenced by food insecurity, Y^*, there will be endogeneity problem, (i.e. $E(\varepsilon_i X_{14i} \neq 0$; $E(\varepsilon_{1i}\, \varepsilon_{2j} \neq 0$ for $i \neq j$) (Greene, 2012). This implies that, ordered probit model will not produce consistent estimates of β_i parameters using maximum likelihood (ML) method. However, to obtain consistent estimates of β_i parameters from the maximum likelihood procedure, a vector z_i containing the relevant instrumental variables such that $E(\varepsilon_i z_i) = 0$ and $E(\varepsilon_{1i}\, \varepsilon_{2j} = 0$ for $i \neq j$), was required. The full specification of the simultaneous equation model, taking into consideration the assumption that underlies the endogeneity of X_{14i}(asset score) is given as:

$$Y_1 = \beta_1 X_{1i} + \beta_2 X_{2i} + \cdots + \beta_{13} X_{13i} + \beta_{14} X_{14i} + \varepsilon_{1i} \ldots\ldots\ldots\ldots\ldots\ldots \quad (12)$$

$$X_{14} = \beta_1 X_{1i} + \beta_2 X_{2i} + \ldots + \beta_{14} X_{14i} + \beta_{15} X_{15i} + \beta_{16} X_{16i} + \varepsilon_{2j} \ldots\ldots\ldots \quad (13)$$

Where Y_1 and X_{14} are endogenous variables representing food insecurity status and asset score respectively. With the exception of these two endogenous variables (Y_1 and X_{14}), other variables specified in the simultaneous equations model were strictly exogenous. The structural equation was given by Equation (12), while the reduced form equation (13) mainly expresses the variation in strictly exogenous variables only, including a vector z_i consisting of instrumental variables, X_{15i}(per capita expenditure on farm inputs), X_{16i}(ownership of livestock) and X_{17i}(access to credit) that were excluded from the structural equation. This was done to produce the unique estimates for the coefficients of the structural and reduce-form equations. There is a difficulty in making use of Full Information Maximum Likelihood (FIML) estimation technique because it requires rigorous computational procedure and is time-demanding especially when it comes to ordered choice model. However, Stata user-written "cmp" (Roodman, 2009) has the routine to conveniently estimate this model.

RESULTS AND DISCUSSION

Distribution of Respondents based on Socio-Economic Characteristics

Table 4.1 shows the distribution of the respondents based on the socio-economic factors. The result shows that majority of the sampled population were male (81.4%), married (90.7%), had 6-10 members of household (61.1%). Also, majority (60%) of the respondents were between the ages of 36 and 55 years, while 7.40% aged 35 years or less. The mean age of the sampled population was about 52 years suggesting downward trend in the ability of the respondents to effectively carry out labour-intensive rural agriculture. There was high level of literacy as

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90.9% of the respondents completed at least primary education, while only 9.04% had no formal education. The mean years of formal education was approximately 10 years. The high literacy level suggests the ease with which farming households adopt innovations and improved technologies.

The primary occupation for most of the respondents was farming (78.6%), with an average sixteen (16) years of experience. This suggests that most of the respondents were likely to benefit from improved productivity and earning capacity. Majority of the respondents belonged to at least one local level institution (74.5%), had access to at least a source of microcredit (74.5%). Considering the mean monthly income of the respondents, the results from table 4.1 show that one-quarter (25.5%) of the respondents earned above N60,000 monthly, while 35.6% earned at most N30,000 monthly and 38.63% earned between N30,001 and N60,000 monthly. The mean monthly income in the study area was N57, 422.30.

Distribution of Respondents by Access to Livelihoods' Assets

The results as presented in the table 4.2 shows that 52.8%, 32.6% and 14.5% had high, moderate and low levels of access to natural asset respectively. This implies that, above average of the sampled population relied on natural asset for their livelihoods. Inadequate tenure rights to natural resources, coupled with extreme weather events and environmental degradation often result in poverty and hunger. For physical asset, majority (63.2%) of the respondents were highly endowed, while 13.1% and 23.6% had moderate and low levels of access to physical asset respectively. Seng (2015) reported that access to physical asset enhances or supports the capability of individuals or households to undertake productive activities in order to earn their means of living including income and food.

Further, majority (77.8%) of the respondents were highly endowed with human asset, while about 13.2% and 9.0% were moderately and poorly (low) endowed. The high possession of human assets among the respondents was likely to strengthen their productive capacity for improved well-being including access to adequate food. However, for financial asset, it was shown that, majority (60%) of the respondents were poorly (low) endowed with financial assets, while 2.7% and 37.3% were moderately and highly endowed respectively. The implication is that, the ability of the most respondents to achieve a successful livelihood might be affected. For social assets, the results from table 4.2 revealed that, majority (72.6%) of the respondents were highly endowed with social asset, while 6.58% and 20.82% were moderately and poorly endowed respectively. Lim *et al*. (2015) reported that social asset enhances human resilience that has the capability to reduce the risk of falling further into income and food poverty.

From the aggregate point of view, the results from table 4.3 show that 66.6% of the respondents were poorly endowed with aggregate livelihoods' assets compared to 33.4% of the respondents with high level of access to aggregate livelihoods' assets suggesting that majority of the respondents lacked the capabilities to pursue a successful livelihood. This finding notwithstanding the high level of household's access to most of the other asset categories previously discussed, it underscores the importance of access to financial asset irrespective of access to natural, physical, social or human asset.

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Table 4.1: Distribution of Respondents by Socio-economic Characteristics

Characteristics	Frequency	Percent
Gender of Household head		
Male	297	81.37
Female	68	18.63
Age of Household head		
≤35	27	7.40
36-45	98	26.85
46-55	20	32.87
56-65	72	19.73
>65	48	13.15
Mean	51.92	(11.38)
Marital status		
Married	331	90.68
Single	14	3.84
Widowed	17	4.66
Divorced	3	0.82
Household size		
1-5	87	3.84
6-10	223	61.10
11-15	47	12.88
>15	8	2.99
Mean	8	3
Education		
No formal education	33	9.04
Primary	94	25.75
Secondary	123	33.75
Tertiary	115	31.51
Primary Occupation		
Farming	287	78.63
Non-farming	78	21.37
Farming Experience		
≤10	152	41.64
11-20	114	31.23
>20	99	27.13
Mean	16.76	(10.57)
Access to credit		
No	93	25.50
Yes	272	74.52
Organization membership		
No	93	25.50
Yes	272	74.52
Monthly income		
≤30,000	58	15.89
30,001-60,000	93	25.50
>60,000	214	58.63
Mean	57,422.30	(59,236.4)

Source: Author's computation from field survey, 2019. Values in parenthesis are standard deviation

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Table 4.2: Distribution of Respondents by Access to Livelihoods' Assets (Disaggregated)

Assets categories	Frequency	Percent	Endowment Status
Natural	53	14.52	Low
	119	32.60	Moderate
	193	52.88	High
Physical	86	23.56	Low
	48	13.15	Moderate
	231	63.29	High
Human	33	9.04	Low
	48	13.15	Moderate
	284	77.81	High
Financial	219	60.00	Low
	10	2.74	Moderate
	136	37.26	High
Social	76	20.82	Low
	24	6.58	Moderate
	265	72.60	High

Source: Author's computation from field survey, 2019

Table 4.3: Distribution of Respondents by Access to Livelihoods' assets (Aggregated)

Asset score interval	Frequency	Percent (%)	Endowment status
<16,229.09	243	66.58	Low
≥ 16,229.9	122	33.42	High
Mean asset score	16,229.09		
Standard deviation	26,264.55		

Source: Author's computation from field survey, 2019

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Distribution of Respondents by Rural Livelihoods' Choices

The results as presented in table 4.4 revealed that four mutually exclusive choices of rural livelihoods were identified in the survey. The least-pursued choice of rural livelihoods was "on-farm" (Agriculture) consisting of 3.56% of the respondents. This was the modal choice of livelihoods pursued. The inability of most respondents to commercialise their production through investment in improved technologies that provide them with competitive advantage might be responsible for crowding-out majority of the respondents from this livelihoods choice. About 17.8% and 9.7% pursued ONF-OF and ONF-NF rural livelihoods' choices respectively, while majority (58.9%) of the respondents pursued the most-diversified choice of rural livelihoods involving ONF-OF-NF combination.

Table 4.4: Categorisation of Respondents by Rural Livelihoods' Choices

Livelihood activities	Livelihoods' choice	Frequency (n=365)	Percent (%)
Production of food and cash crops; Livestock and fisheries/aquaculture	On-farm (Agriculture)	13	3.56
Production of food and cash crops, Livestock and fisheries/aquaculture; Agricultural wage labour, Environmental gathering and rent	On-farm + Off-farm	65	17.81
Production of food and cash crops, Livestock and fisheries/aquaculture; Salaried job (Private & Government), Trading, Craft & Artisans, Transfers, Remittances and pension	On-farm + Non-farm	72	19.73
Production of food and cash crops, Livestock and fisheries/aquaculture; Agricultural wage labour, Environmental Gathering and rent of farm land; Salaried job (Private & Government); Trading, Craft & Artisans, Transfers, Remittances and pension	On-farm + Off-farm + Non-farm	215	58.90

Source: Author's computation from field survey, 2019

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Distribution of Respondents by Food Insecurity Status

Table 4.6 presents the distribution of the respondents by food insecurity categories. The results show that considerable number of the studied population were food insecure with 4.38% and 35.89% were core and moderately food insecure respectively, while about 59.73% of the respondents were non-food insecure (food secure).

Table 4.5 Categorization of Households by Food Insecurity Status

Food Consumption Scores (FCS)	Frequency	Percentage	Food insecurity Status
$y^* \leq 21$	16	4.38	Core food-insecure
$21 < y^* \leq 35$	131	35.89	Moderately food-insecure
$y^* > 35$	18	59.73	Non-food insecure

Source: Author's computation from field survey, 2019.

Food Insecurity Profile of the Respondents by Socio-economic characteristics

The classification of households into core, moderate and non-food insecure categories was done in order to link the differences in food insecurity status to household's profile as shown in table 4.7. It was revealed that, the percentage of the food insecure were found to be higher among households headed by female with 7.4% and 42.7% were core and moderately food insecure respectively, compared with male-headed households with 3.7% and 34.3% were core and moderately food insecure respectively. FAO, (2015) corroborated this finding, reporting that in rural Nigeria, food insecurity is more prevalent among the women and children, thus implying widespread malnutrition among the vulnerable group. The relatively younger household heads of 45 years of age or less were the age group with the highest percentage of food insecure with about 10.4% and 40.8% were core and moderately food insecure respectively, while the lowest percentage of the food insecure was found among households who were older than 65 years of age with 14.6% experienced moderate food insecurity and no one experienced core-food insecurity. The possible reason is that, older household heads of above 65 years were more likely to have the least dependence ratio as most of their children would have grown up and likely to be found in the active productive age with the ability to adequately cater for the needs of their parents. Also, it was shown that, the married among the respondents were more food insecure with 4.5% and 37.5% were core and moderately food insecure, compared to their counterparts that were not married with 2.9% and 20.6% were core and moderately food insecure respectively.

Household heads who had household size of at most 5 members (8.1% for core and 43.7% for moderately food insecure) were less food insecured, compared to their counterparts with household size of above 5 members (8.8% for core and 80.4% for moderately food insecure). Higher educational attainment was found to be associated with less incidence of food insecurity as 2.5% and 32.8% of the respondents with post primary education were core and moderately

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food insecured respectively, compared to their counterparts with no formal education (with 3.0% and 39.4% were core and moderately food insecure respectively). Osunmakinde, (2016) reported similar findings. Household heads with no access to credit were more food-insecure with 6.6% and 36.6% of the respondents were core and moderately food-insecure, compared to their counterparts who had access to at least a source of microcredit with 34.4% experienced moderate food insecurity and none was core food insecure. This finding is consistent with Keynesian capital and growth theories and also underscore the critical role that access to credit plays in driving the expenditure decision, aggregate demand and as well as in determining the overall level of output, income and access to food. Food insecurity was also found to be more prevalent among household heads who were not members of any social organization with 1.3% and 40.5% were core and moderately food insecure respectively, compared to their counterparts who were members of social organization with 5.24 and 34.6% were core and moderately food insecure respectively.

The prevalence of food insecurity was found to be higher among household heads that resided in savannah or derived savanna agro-ecological zone with 5.1% and 42.1% were core and moderately food insecure respectively, compared to their counterparts who resided in rain forest agro-ecological zone with 1.5% and 8.8% were core and moderately food insecure respectively. The inverse relationship between membership of social organization and food insecurity status of the households also corroborates the existing literature on the role of social capital.

In terms of access to livelihoods' assets, household heads who were highly ranked in terms of access to livelihoods' assets were less food insecure with 1.64% and 27.05% were core and moderately food insecure respectively, compared to their counterparts with poor access (i.e. low) to livelihoods' assets (with 5.76% and 40.33% were core and moderately food insecure respectively). This implies that, with assets, individuals and households have the capacity to build their resilience to mitigate various adversities when faced with shocks and stresses (Kassie *et al.,* 2016). With respect to the choice of livelihoods, results show that the least percentage of food insecure households was found among those who derived their livelihoods exclusively from on-farm activities (ONF livelihoods' choice) with 21.43% were moderately food insecure and none was core food-insecure, while the highest percentage of food insecure was found among those who diversified into off-farm and non-farm activities (ONF-OF-NF) with 5.6% and 41.9% were core and moderately food insecure respectively. The foregoing suggests that livelihood diversification in the study area was survival-led or distress driven.

Endogeneity of Asset Score in Food Insecurity Model

Table 4.7 presents the result of IV-ordered probit estimation of food insecurity model. The results show that the overall fitness of the model, as shown by the log likelihood estimate of4332.905 and Chi^2 value of 464.67 was statistically significant thus implying a good fit of data.

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Table 4.6: Food Insecurity Profile of Farming Households in Rural Southwestern Nigeria

Variables	Core Food Insecurity	Moderately Food Insecure	Core Food Insecure
Sex			
Male	3.70	34.34	61.95
Female	7.35	42.65	50.00
Age			
0-45	10.4	40.8	48.80
46-65	1.56	38.02	60.42
>65	0.00	14.58	85.42
Marital status			
Married	4.53	37.46	58.01
Not married	2.94	20.59	76.47
Household size			
1-5	8.05	43.68	48.28
6-10	8.83	80.39	10.78
> 10	0.00	75.00	25.00
Education			
Non-formal	3.03	39.39	57.58
Primary	9.57	42.56	47.87
Post Primary	2.52	32.77	64.71
Credit			
No	6.58	36.63	56.79
Yes	0.00	34.43	65.57
Social membership			
No	1.27	40.51	58.23
Yes	5.24	34.62	60.14
Agro-ecological zones			
Rain forest	1.47	8.82	89.71
Others	5.05	42.09	52.86
Asset Status			
Low	5.76	40.33	53.91
High	1.64	27.05	71.31
Livelihoods' Choice			
ONF	0.00	21.43	78.57
ONF-OF	0.00	29.68	39.06
ONF-NF	5.56	26.39	68.06
ONF-OF-NF	5.58	41.86	52.56

Source: Author's computation from field survey, 2019. ONF = On-farm, ONF-OF= On-farm with off-farm, ONF-NF= On-farm with non-farm, ONF-OF-NF= On-farm with off-farm and non-farm.

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Furthermore, the coefficient of anthrho (ρ) statistics is 0.0705 and not significant, implying the acceptance of null hypothesis of exogeneity (no endogeneity) of the asset variable, X_{14}.

However, in the absence of direct method for conducting post estimation test involving identification and validity of the instruments in models such as IV-Ordered probit, further attempt was made to analyse the food insecurity, (y^*) model using the 2-stage least square estimation (with instrumental variable) procedure. The 2-stage least-square estimation of over-identified equation also enables this study to check the consistency or otherwise of IV-ordered probit result.

The result as presented in table 4.8 revealed that, the overall fitness of the model as shown by the Chi^2 value of 133.21 was statistically significant indicating a good fit. Furthermore, tables 4.9 and 4.10 present the post estimation results of the 2-statge least square. The result from table 4.9 revealed that the critical values of Sargon and Basmann statistics indicated by Chi^2 values of 3.7500 and 3.5917 respectively were not significant implying that the null hypothesis of no correlation between the instruments and the error term was accepted indicating that the selected instruments were valid. Furthermore, table 4.10 presents the results of Durbin-Hu-Hausman test. The results revealed that, the critical values of Wu-Hausman and Durbin Watson statistics indicated by Chi^2 values of 0.6883 and 0.7225 respectively were not significant, implying the acceptance of null hypothesis of no endogeneity in the model. This test confirmed that the asset score was indeed exogenous.

Table 4.7: Result of IV-Ordered Probit Estimation (FIML) of Food Insecurity (simultaneous equation) Model

Variable Stage 1	Coefficients	Z-value	Variable Stage 2	Coefficients	Z-value
Food insecurity status			Asset score		
Age	0.0413	3.94***	Age	150.6132	1.17
Gender	0.0606	0.29	Sex	- 721.1459	-0.24
Marital status	0.4118	2.60***	Marital status	-1856.7730	-0.89
Post pry education	0.5083	2.99***	Post pry education	5581.8890	2.37**
Household size	0.0523	1.59*	Household size	1371.7510	3.00**
Primary occupation	-0.0278	-0.14	Primary occupation	9184.1970	3.27***
Farming experience	-0.0297	-2.95***	Farming experience	209.1861	1.61*
Dependent ratio	0.0129	0.35	Dependent ratio	-1854.5000	-4.20***
Irrigation	0.4246	1.92**	Irrigation	2274.9220	0.72
Extension	-0.0183	-3.10***	Extension	-146.2126	1.60*
contact	-0.6574	-3.70***	contact	4808.658	1.99**
National grid i. Livelihoods' choice			National grid i. Livelihood strategy		

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ONF-OF	-0.3134	-0.73	ONF-OF	-5386.7210	-0.93
ONF-NF	-0.4634	-1.09	ONF-NF	4946.5810	0.87
ONF-OF-NF	-0.7704	1.94	ONF-OF-NF	-156.2226	-0.03
Asset score	0.0199	3.82***	Expenditure on agric. inputs	0.2300	5.08***
			Access to credit	25725.04	11.18***
Model summary			Livestock ownership	2188.436	0.95
No of observation:	365		Constant	-2561.75	-2.95***
Wald $Chi^2(34)$	464.67		Cut_1_1	-0.2384	2.69**
Prob. > Chi^2	0.0000		Cut_1_2	1.7342	265.91***
Log likelihood	-4332.905		**Atanhrho_12**	**-0.0705**	**-0.50**
			rho_12	-0.0704	

Source: Author's computation from field survey, 2019. ***, ** and * indicate 1%, 5% and 10 levels of significance. Instrumented variable: Asset score. Instruments: Per capita expenditure on agricultural inputs, access to credit and livestock ownership. Constant term was not reported for food insecurity equation in Stata. Thus, two cuts-off values are reported. ONF-OF = On-farm + off-farm livelihood; ONF-NF = On-farm + Non-farm livelihood; ONF-OF-NF = On-farm + off-farm + non-farm livelihood.

Table 4.8: Result of 2 stage least-square (instrumental variable) Estimation of Food Insecurity model

Food insecurity scores	Coefficient	Z-value
Age	0.1219	1.69*
	(0.0718)	
Gender	-0.0083	0.005
	(1.6590)	
Marital Status	2.3705	2.05**
	(1.1545)	
Post primary education	4.7797	3.64***
	(1.3142)	
Household size	0.5130	2.04**
	(0.2513)	
Primary occupation	-0.0762	-0.05
	(1.6048)	
Farming Experience	-0.0094	-0.13
	(0.0707)	
Dependent ratio	-0.2354	-0.89
	(0.2642)	
Irrigation	5.0587	2.92**
	(1.7333)	
Extension contact	-0.2334	-4.88***
	(0.0478)	

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National grid	-2.7487		-2.06**
	(1.3346)		
Agro-ecological zone	0.4681		0.27
	(1.7183)		
Asset score	0.1643		4.13***
	(0.0398)		
On-farm + off-farm	-1.4369		-0.45
	(3.1773)		
On-farm + non-farm	-0.7657		-0.25
	(3.1228)		
On-farm + off-farm+ non-farm	-5.2571		-1.80*
	(2.9205)		
Constant	28.8646		5.99***
	(4.8168)		
Model Summary			
No of observation:	365		
Wald $Chi^2(6)$:	133.21	Prob. > Chi^2:	0.0000
R-square:	0.2903		
Root MSE:	10.336		

Source: Author's computation from field survey, 2019. *, ** and *** indicate levels of significance at 10%, 5% and 1 % respectively. **Instrumented:** Asset score. **Instruments:** Age, sex, marital status, post primary education, household size, primary occupation, farming experience, dependent ratio, irrigation, extension contact, national grid, agro-ecological zone, i. Livelihood strategy, per capita expenditure on agricultural inputs, livestock ownership and access to credit.

Table 4.9: Test of Validity of the Instruments

H_0= Instruments are valid

Statistics	Critical values	P-values
Sargon, $Chi^2(2)$	3.7500	0.1534
Basmann, $Chi^2(2)$	3.5917	0.1660

Source: Author's computation from field survey, 2019.

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Table 4.10: Result of Hausman Test of Endogeneity

H_0 = Exogenous of asset score (i.e. no endogeneity in the model)

Statistics	Critical values	P-values
Durbin (score), $Chi^2(1)$	0.7226	0.3953
Wu-Hausman, F(1, 347)	0.6883	0.4073

Source: Author's Computation from Field Survey, 2019.

The results of further tests involving the validity of the selected instrumental variables as well as their explanatory strength and correlation with the error terms were presented in the appendix section. The results of the two tests involving the correlation of the selected instruments with the error terms and that of the endogeneity confirmed that the estimates obtained from single equation ordered probit model were indeed unbiased, consistent and efficient and that the use of IV-ordered-probit model in the absence of endogenous variable produce consistent but not efficient estimates (Greene, 2012).

Influence of Rural Livelihoods on Food Insecurity Status

Ordered probit model was estimated in order to determine the food insecurity influence of socio-economic characteristics, assets and rural livelihoods of farming households. The result as presented in table 4.11 revealed that, the overall fitness of the model as shown by the log likelihood estimate of 220.62 and the LR statistics indicated by Chi^2 value of 152.01 was statistically significant at less than 1%. This indicates that the model adequately fits the data. The test for multicollinearity involving Variance Inflation Factor (VIF) was presented in the Appendix. The VIF for all the specified independent variables ranged from 1.24 to 7.05 with an average of 2.46. Since the average VIF value is less than 10, this implies that that there is no serious concern for multicollinearity in the specified models.

Focusing on key variables of interest, the results from table 4.12 revealed that, out of the five categories of livelihoods' assets specified in model 1, financial-asset score was the only category that had significant influence on food insecurity status. The probable reason is that financial asset drives other asset types (e.g. natural, physical, human, and social assets) particularly for farm and non-farm activities such that, the outcomes obtained including income and food *inter alia*, depend on the intensity of committing financial asset to the activities. As expected, the coefficient of financial-asset score is positive and significantly influences food insecurity status. The estimates of marginal effect show that an increase in financial-asset scores by a unit increases the probability of food security experiences by 16.3%, while the probabilities of moderate and core food insecurity experiences were reduced by 12.1% and 42.1% respectively. Unmesh and Narayanan, (2015); Kasim *et al.*, (2017) reported similar findings. Access to financial asset including credit, household valuables such as jewelry, livestock and remittances tends to increase the aggregate demand of farming households for factor inputs and consequently increase their output level, income and thus access to adequate and nutritious food.

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The influence of on-farm with off-farm (ONF-OF) and that of on-farm with non-farm (ONF-NF) livelihoods on food insecurity status of the respondents were not significant. These findings are contrary to Jemal and Kim, (2014); and Yishak *et al.* (2014), but consistent with Martin and Lorenzem, (2016) who argued that "distress-push" diversification prevails in low resilient agro-ecological zone characterised with high risk of droughts, flooding and land degradation. This finding implies that, the low productivity arising from low- resilient agricultural environments coupled with farmers' poor resource-base was likely to force the respondents to strive for improved earnings by participating in low rewarding non-farm activities, thus resulting in a more stable but lower income with attendant consequence of food insecurity.

The coefficient of combined on-farm, off-farm and non-farm (ONF-OF-NF) livelihood, relative to ONF was negative and significantly influences food insecurity status. The marginal effects estimates show that the choice of combined ONF-OF-NF rural livelihoods decreases the likelihood of food security (non-food insecure) experience by 20.8% and it increases the probability of moderate and core food insecurity experiences by 16.9% and 3.9% respectively. This finding implies that combined ONF-OF-NF livelihood was driven by a necessity brought about by negative conditions that compel the respondents to combine different activities as a form of adaptation to survive (McClananhan and Wamukota, 2010). This finding is however contrary to Asmelash, (2014); Yishak *et al.* (2014).

Contrary to the expectation, the coefficient of age was positive and significantly influences food insecurity status. The estimates of marginal effect show that an increase in age of the respondents by a year increases the likelihood of food security (non-food insecurity) experience by 1.2%, but it reduces the likelihood of moderate and core food insecurity experiences by 0.9% and 0.3% respectively. This finding could be attributed to the effect of error correction mechanism over the years in farming and agricultural practices that has translated into improved farm productivity in the form of better yield, enhanced income and increased access to adequate and nutritious food. This finding is consistent with Fekadu and Mequanent, (2010) but inconsistent with Oni and Salman, (2011).

The influence of marital status on food insecurity status was significant. The marginal effect estimates show that being married increases the likelihood of food security (non-food insecurity) experience by 10.7%, while it reduces the probability of household's experience of moderate and core-food insecurity by 8% and 2.8% respectively. This finding is inconsistent with *a priori* expectation, Adepoju and Adejare, (2010); Oni and Fasogbon, (2013). The possible reason is that, agriculture which is a major occupational source for people in rural Africa including Nigeria (World Bank, 2008) is subsistent and depends majorly on family labour. Hence, Married household heads were more likely to spend less on labour input thereby resulting in higher productivity and improved access to adequate food. As expected, post primary educational attainment of household heads had significant influence on food insecurity status. The estimate of marginal effect shows that an increase in the level of post primary educational attainment increases the likelihood of food security (non-food secured) experience by 10.9%, while it reduces the probability of household's experience of moderate and core-food insecurity by 8.1% and 2.8% respectively. This finding is consistent with Adepoju and Adejare, (2013) and Mensah, (2014). The implication is that access to post primary education enhances the human capacity of household heads in terms of better access to innovative and improved production technologies, including access to e- extension and communication services that together enhance their productivity, income and access to adequate and nutritious food.

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The influence of household size on food insecurity status was significant. The marginal effects estimates showed that a member increase in household size increases the likelihood of household's experience of food security (non-food insecure) by 1.7%, but it decreases the likelihood of household's experience of moderate and core-food insecurity by 1.2% and 0.4% respectively. This is contrary to the prior expectation and inconsistent with Asmelash, (2014); Jemal and Kim, (2014). The possible reason is that the traditional farming practices in most developing nations including Nigeria depend heavily on family labour. Hence, the incentive to increase farm size was driven by large family size and its attendant reduction in labour input cost. Consequently, the efficiency with which the labour inputs were allocated has the potential to guarantee enhanced income that determine food insecurity status.

The coefficient of farming experience negatively and significantly influences food insecurity status. The marginal effect estimates show that an increase in farming experience by a year reduces the probability of moderate and non-food insecurity (food security) experiences by 0.5% and 0.7% respectively, while it increases the likelihood of core-food insecurity experience by 0.2%. Although this finding is contrary to the prior expectation, it revealed important information that suggests that farming experience, productivity and food insecurity are not linearly related. The possible reason is that, theoretically, years of farming experience cannot permanently increase productivity. It may at first set of years of farming experience increases productivity; productivity tends to decline at a stage when diminishing return to extra years of farming experience set in.

The influence of irrigation access on food insecurity status was significant. The marginal effect estimates show that access to irrigation facilities increases the likelihood of food security (non-food insecure) experience by 13.8%, and it decreases the likelihood of moderate and core-food insecurity experiences by 10.2% and 3.6% respectively. This finding is consistent with *a priori* expectation, Oni and Fashogbon, (2013) and Jemal and Kim, (2014). It can be deduced that access to irrigation extends the production cycle of farming households beyond the conventional reach of rain-fed agriculture. Studies have also found that rain-fed agriculture is less productive, compared to irrigated agriculture.

The coefficient of frequency of extension contacts is negative and significantly influences the food insecurity status. The marginal effect estimates show that the frequency of contacts with extension agents decreases the likelihood of food security (non-food security) experience by 0.4%, while the probabilities of moderate and core-food insecurity experiences were increased by 0.3% and 0.1% respectively. This finding is inconsistent with prior expectation and Asogwa and Umeh, (2012). The possible reason is that access to extension services is a necessary condition but not sufficient to achieve improved productivity, particularly when the respondents were late adopters or even laggards (non-adopters) of improved technologies. Furthermore, access to national grid/electricity negatively and significantly influences the food insecurity status of the respondents. The marginal effects estimates show that access to national grid/electricity reduces the likelihood of food security (non-food insecurity) experience by 16.2%, while the probability of moderate and core food insecurity experiences were increased by 12% and 4.2% respectively. This finding is inconsistent with *a priori* expectation. This may be attributed to the fact that that access to national grid does not automatically translate into improved living condition including secured access to food. In the face of erratic or persistent collapse of national grid, no gainful investment or enterprise can thrive. This finding suggests that, lack of effective service delivery and its attendant poor power supply are capable of restricting the ability of farming households to secure improved livelihood from diversifying into rural non-farm activities.

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Table 4.18: Influence of Rural Livelihoods on Food Insecurity Status of Farming Households in Southwestern Nigeria

Variables	Model 1 (with disaggregated livelihood asset)				Model 2 (with aggregate livelihood asset)			
		$\frac{\partial Pr(Y=2)}{\partial X}$	$\frac{\partial Pr(Y=1)}{\partial X}$	$\frac{\partial Pr(Y=0)}{\partial X}$		$\frac{\partial Pr(Y=2)}{\partial X}$	$\frac{\partial Pr(Y=1)}{\partial X}$	$\frac{\partial Pr(Y=0)}{\partial X}$
Food Insecurity status	Coefficient	Core-food insecure	Moderately-food insecure	Non-food insecure	Coefficient	Core-food insecure	Moderately-food insecure	Non-food insecure
Age	0.0417	-0.0030(3.28)***	-0.0085(-4.08)***	0.0115(4.19)***	0.0417	-0.003(3.38)***	0.8712(4.23)***	0.0117(4.37)***
Sex	0.0644	-0.0046 (-0.30)	-0.0131(-0.30)	0.0177 (0.30)	0.0547	-0.0039 (-0.27)	-0.0113(-0.27)	0.0152 (0.27)
Marital status	0.3913	0.0277(-2.27)**	-0.0796(-2.51)***	0.1073(2.53)***	0.4053	-0.0291(2.33)**	-0.0835(2.60)**	0.1126 (2.62)**
Post Pry education	0.3977	-0.0282(-1.40)*	-0.0809 (-1.43)*	0.1090 (1.44)*	0.5228	-0.0375(2.78)***	-0.1077(3.14)**	0.1452(3.21)***
Household size	0.0604	-0.0043(-1.74)**	-0.0123 (-1.84)**	0.0166 (1.84)**	0.0550	-0.0039 (1.62)*	-0.0113 (1.70)*	0.0153 (1.70)*
Primary occupation	0.0709	-0.0050 (-0.39)	-0.0144 (-0.39)	0.0194 (0.39)	0.0012	-0.0008 (-0.01)	-0.0002 (-0.01)	0.0003 (0.01)
Farming Experience	-0.0257	0.0018(2.28)**	0.0052(2.53)***	-0.007(2.55)***	-0.0210	0.0022 (2.62)***	0.0062(3.05)***	-0.0083(3.07)**
Dependent ratio	-0.0060	0.0004 (0.17)	0.0012 (0.17)	-0.0016 (-0.17)	0.0071	-0.0507 (-0.20)	-0.0015 (-0.20)	0.0020 (0.20)
Irrigation	0.5018	-0.0356(-2.05)**	-0.1020 (-2.18)***	0.1376(2.20)***	0.4320	-0.3099 (-1.87)*	-0.0890(1.96)**	0.1200 (1.97)**
Extension contact	-0.0149	0.0011 (2.16)**	0.0030 (2.33)**	-0.004(2.36)***	-0.0182	0.1307(2.70)***	0.3756(3.13)***	-0.005(3.17)***
National grid	-0.5912	0.0419 (2.76)***	0.1202 (3.23)***	-0.162(3.27)***	-0.6499	0.0466 (3.07)***	0.1339(3.73)***	-0.180(3.81)***
Agro-ecological zone	0.5167	-0.0366(-1.76)**	-0.1051(-1.90)**	0.1417(1.90)**	0.5404	-0.0388(-1.91)**	-0.1114(2.10)**	0.1505(2.10)**
Natural asset score	-0.0599	0.0039 (1.01)	0.0114 (1.04)	-0.0153(-1.04)	-	-	-	-
Physical asset score	-0.0599	0.0039 (1.01)	0.0114 (1.04)	-0.0153 (-1.04)	-	-	-	-
Human capital score	0.0206	-0.0015(-0.44)	-0.0042(-0.45)	0.0057 (0.45)	-	-	-	-
Financial asset score	0.5940	-0.4210(3.56)***	-0.1210(-4.82)***	0.1630(4.96)***		-	-	-
Social asset score	-0.1311	0.0093(0.98)	0.0267(0.99)	-0.0360(-0.99)	-	-	-	-
Aggregate asset score	-	-	-	-	0.0183	-0.0131(3.40)**	-0.3770(4.54)**	5.0900(4.63)***

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ONF-OF livelihood	-0.3992	0.0143 (1.02)	0.0864(0.94)	-0.1007(-0.96)	-0.3289	0.0117(0.85)	0.0719(0.78)	-0.1048(-0.80)
ONF-NF	-0.4895	0.0190 (1.34)	0.1063 (1.16)	-0.1252(-1.20)	-0.4508	0.0178 (1.25)	0.0990 (1.09)	-0.1169(-1.13)
ONF-OF-NF	-0.7858	0.0393 (2.86)***	0.1691 (1.96)*	-0.2085(2.15)**	-0.7718	0.0402(2.86)***	0.1678(1.96)*	-0.2081(-.16)**
Model summary						Model		
No of observation:	365					summary	365	
LR $Chi^2(20)$:	152.01	Prob. : 0.0000				Observation:	152.01	Prob. :0.0000
Pseudo R^2 :	0.2562					LR $Chi^2(20)$:	0.2562	
Log likelihood :	220.6246					Pseudo R^2 :	-220.62462	
						Log likelihood :		

Source: Author's computation from field survey, 2019. ***, ** and * indicate 1%, 5% and 10% levels of significance respectively. Values in parenthesis are Z-values. ONF-OF = On-farm + off-farm livelihood; ONF-NF = On-farm + Non-farm livelihood; ONF-OF-NF = On-farm + off-farm + non-farm livelihood.

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Conclusion of the Study

The main focus of this study was to determine the influence of rural livelihoods on food insecurity status of farming households in Southwestern Nigeria. Based on the analysis from the descriptive and inferential statistics, the study found that most of the respondents were male and smallholder farming household heads with average farm size of about 3ha. Majority of the respondents were poorly endowed with financial asset. The choice of combined on-farm, off-farm and non-farm was the most pursued livelihood among the respondents in rural southwestern Nigeria. It was found that about 4.38% and 35.40% of the sampled population experienced core and moderate food insecurity respectively, while 59.73% were non-food insecure (food secure). The prevalence of food insecurity was found to be higher among female-headed households among the asset-poor and most livelihood-diversified households. Therefore, on-farm rural livelihood relative to combined on-farm with off-farm and non-farm, reduced food insecurity among farming households in Southwestern Nigeria.

Policy Implication of the Study

i. Access to financial asset was found to significantly reduce the probability of being food insecure. This finding necessitate the need for improved and inclusive access to financial asset by farming households in the Southwestern Nigeria through credit facility.

ii. Household size was found to negatively and significantly influence the probability of being food insecure thus implying the labour intensive farming system in Southwestern Nigeria. Thus, any policy aimed at substituting labour for improved technology is plausible.

iii. Access to irrigation was found to have significant positive influence on the probability of food insecurity experience. This implies that improved awareness and investment in irrigated agriculture has the potential to enhance the productivity of rural agriculture.

iv. Post primary education is a significant variable that has significant negative influence on probability of being food insecure. This finding offers useful insights for policy makers on targeting and selection of potential beneficiaries for intervention programme.

v. Being resident in derived savanna or savanna agro-ecological zone increases the risk of being vulnerable to food insecurity. Social protection policy that is designed to enhance the rural livelihoods should give special consideration to the people of these zones.

vi. Specialisation in on-farm (agriculture) livelihood was found to significantly reduce the probability of food insecurity experience. This implies that, if commercialised, agriculture has the potential to lift people out of food poverty.

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WOMEN AND MOBILE PHONE CHARGING BUSINESS IN NIGERIA: A CAPABILITY PERSPECTIVE

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ABSTRACT: *There is a growing adoption of solar home systems to support sustainable development and address poor electricity supply in sub-Saharan Africa (SSA). This has resulted in the rise of solar mobile phone charging businesses, especially in off-grid communities. An area that remains under-researched that needs to be addressed is how these solar mobile phone charging businesses provide opportunities for women in rural communities in SSA. We employ the concept of Sen's Capability Approach to evaluate how the solar mobile phone charging businesses have improved the lives of women by focusing on opportunities provided for expanding their freedom to participate in social, economic, and political activities. Our analysis shows that women's involvement in solar mobile phone charging businesses has enhanced their individual and collective capabilities to participate in development activities; however, certain contextual factors hinder the generation of these capabilities. The paper concludes with some implications for theory and practice.*

KEYWORDS: Solar mobile phone charging, women, capability approach, Nigeria.

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INTRODUCTION

In Nigeria, eighty-five million people do not have access to grid energy (World Bank, 2021). This equates to 43 per cent of the country's population, making Nigeria the country with the world's most significant energy access gap. Over the last decade, there has been an increase in mobile phone penetration in sub-Saharan Africa (SSA). In 2020, 495 million people in SSA had signed up for mobile services, accounting for 46 per cent of the region's population (GSMA, 2021). However, while mobile phone penetration is high in urban cities, rural communities have had poor penetration due to lack of mobile infrastructure. Even in areas where mobile services are available, mobile phone users in off-grid communities have a significant problem in charging their phones because they must travel to nearby on-grid communities to charge their phones. The lack of available electricity for recharging a mobile phone restricts the usage of mobile phones (Wyche & Murphy, 2012). It denies many people in off-grid communities the opportunity to engage in society's social, political, and economic activities. The demand for phone charging appears to be one of the significant drivers for rural electrification (Collings, 2011). Communities can get by with traditional cooking fuels and kerosene lighting; however, mobile phones require electricity to operate. As such, there has been an increasing interest in the implementation of solar power solutions which include mobile phone charging options as a leapfrog technology for national economic growth (Munro et al., 2016).

The uptake in sustainable models for off-grid electrification, such as solar home systems, has seen an increase in mobile phone charging businesses in rural areas (Munro & Schiffer, 2019). Even though the solar energy sector is still young in SSA, there have been a few studies that have examined the role of solar electricity generation to support the development of ICTs (Paul & Uhomoibhi, 2014), models for designing and implementing solar mobile charging stations (Udayalakshmi & Mohammed, 2018) and practices of mobile phone charging (Munro & Schiffer, 2019). Although these studies are clustered around mainly economic assessment, adoption, design and implementation issues (Aarakit et al., 2021), very little is known on how these solar mobile phone charging businesses contribute to the lives of the poor in rural communities. Also, gender is usually neglected in the energy discourse in the global south. Yet, the growing body of literature shows that the use and access to sustainable innovations are significantly gendered (Ojongo, 2021). There is a call for the incorporation of gender research within the information and communication technologies for development (ICT4D) research (Walsham, 2017; Mohanty & Mishra, 2020).

In an attempt to answer this call, the study draws up a qualitative case study via in-depth interviews to examine how the mobile phone charging business contributes to the lives of women residing in an off-grid village in Nigeria. The paper's contributions are in two folds: Firstly, it extends our knowledge of how ICT led initiatives within the energy sector impact the lives of women in the global south. Secondly, it provides implications to practice that policymakers can use to further enhance the contribution of the mobile phone charging business to women's lives in rural Nigeria. The following section provides a literature review on ICTs and development. This is followed by a discussion on ICT4D and its impact on women. Next, Sen's Capability Approach is introduced as a theoretical lens. Next, the methodology is introduced. This is followed by the case study and analysis section. The final section presents the discussion and conclusion.

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LITERATURE REVIEW

ICT and Development

The ICT4D literature contains several areas of development, but little is known on what development means and how ICTs play a key role in these processes (Zheng et al., 2018). Early ICT4D research claims that ICTs will ultimately lead to rapid development. These studies tend to implicitly follow the modernization approach to development that perpetuates western values and suggest the facilitation of market mechanisms such as privatization, deregulations, etc., as a means to economic development in the global south (Pieterse, 2010; Avgerou, 2003). Many donor agencies have promoted ICT4D interventions with this economic reasoning and tend to measure the contribution of ICT in terms of economic growth and market-based innovation. However, many of these ICT4D interventions become problematic in the long run due to the lack of consideration of the contextual factors that shaped the implementation and use of these initiatives in the global south (Sein & Harindranath, 2004). Research following this western approach to development have focused on ICT readiness (Nhamo, Nhemachena & Nhamo, 2020), access and the digital divide (Ohemeng & Ofosu-Adarkwa, 2014) and how ICTs can support economic growth (Appiah-Otoo & Song, 2021).

However, there has been a shift from this dominant approach to development that focuses on economic growth to alternative methods that emphasise on human development. The Amartya Sen's capability approach has been widely used within the ICT4D literature to examine development outcomes in terms of capabilities, wellbeing, choices and agency of individuals to actualize available opportunities (Andersson, Grönlund & Wicander, 2012; Hoque, 2020; Zheng, 2009). At the same time, there is a paucity of studies examining the contribution of ICT4D interventions on rural women's capabilities to attain development outcomes in SSA (Alao, Chigona & Brink, 2021). Within the context of Nigeria, the majority of the studies have either focused on the adoption of ICTs by women (Olejede et al., 2017), access and use of ICTs for agriculture by women (Agwu & Ogbonnah, 2015) and gender and digital divide (Danjuma, Onimode & Onche, 2015). Very few studies in Nigeria have evaluated the human development outcomes of women in terms of empowerment and agency (Abubakar & Dasuki, 2018; Dasuki & Zamani, 2019). In light of this, our study draws up Sen's capability to examine the contribution of ICT4D interventions in expanding the capabilities of women to live a valuable life in Nigeria. We focus on the voices of women who currently run a solar mobile phone charging business and its contribution to their lives. The following section provides a review of literature on the impact of ICT4D on the lives of women in the global south.

ICT4D and its Impact on Women

A growing number of studies have looked at the relationship between ICTs and women empowerment in the global south. For example, a study by Abubakar and Dasuki (2014) in Nigeria showed that WhatsApp had empowered women by concentrating on the opportunities provided for expanding their freedom to participate in social, economic, and political activities. Similarly, a capabilities analysis of a health intervention for pregnant women in Malawi indicated that participants developed informational, economic, and self-development capabilities in addition to the health-related outcomes that the programme was designed to achieve (Nyemba-Mudenda & Chigona, 2017). Focusing on agency, Alhayek (2016) examines how ICT is utilised by women activists in Jordan to advance their reform efforts and better the lives of women (Alhayek, 2016). Similarly, studies by Shirazi (2012) found women's digital

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activities to be an effective tool for engaging in communicative discourse and rallying Iran's female population in their fight for a just and equitable society. Despite the growing number of studies that intersect gender and ICT4D, there is still a paucity of studies (Trauth, 2013; Alao, Chigona & Brink, 2021). There is a call by Walsham (2017) for more gender based studies to understand the contributions of ICTs to development. In an attempt to answer this call, the study examines how the solar mobile charging business contributes to the lives of women in a rural village in Nigeria. Drawing up the Sen's capability approach as a theoretical lens, the study examines the contributions of the solar mobile charging business to the freedom of women to participate in social, economic and political activities. The next introduces the Sen's capability approach which serves as a theoretical lens for this study.

Sen's Capability Approach

The capability approach (CA) is a broad normative framework for assessing changes in society in terms of the enhancement of individual wellbeing (Sen, 1999). The approach critiques the dominant approaches to development that focus on economic growth and opulence and emphasizes *"human freedom"*, which means the effective opportunities available to an individual to live a valuable life. The CA consists of two distinct features: capabilities, which refers to freedoms—individuals have to achieve a set of functions—while functionings are beings and doings that people value.

Robeyns (2005) argues that the difference between capabilities and functionings is between the freedoms on the one hand and achievements on the other. Alkire (2005) noted that it is crucial to focus more on capabilities than functionings because individuals value choices of capabilities from which they can choose. Nevertheless, the realization of functionings is further determined by social, personal and environmental factors. However, CA has been criticized for being individualistic and not taking account of social structures and groups (Corbridge, 2002; Devereux, 2001; Navarro, 2000). Others have called it an incomplete and infeasible framework (Robeyns, 2005), noting that it is problematic to unravel the balance between its conceptual richness and its potential to be operational in practice, research, and development (Kleine, 2010).

Despite these criticisms, there has been a wide range of applications of the framework within ICT4D studies (Bass, Nicholson & Subhramanian, 2013; Kleine, 2010; Grunfeld, Hak & Pin, 2011; Hatakka & Lagsten, 2012). Very few studies have applied the framework to study gender within ICT4D (Masiero, 2022; Walsham, 2017). According to Sen, *"extensive reach of women's agency is one of the more neglected areas of development studies, and most urgently in need of correction."* He emphasizes *"an adequate recognition of political, economic, and social participation and leadership of women to be a crucial aspect of the capability approach"* (Sen, 1999, p. 203). In this paper, we examine the freedoms and opportunities that have been provided to women involved in the solar mobile charging business. The following section introduces a discussion on the methodology.

Methodology

Our empirical findings are based on qualitative interviews conducted with women to examine the developmental opportunities associated with their involvement in the solar mobile charging business. A single case study was adopted due to the scarcity of information on gender within

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the energy sector. The fieldwork was conducted in November 2021 and involved 16 women from Shimankar village in Nigeria involved in solar mobile charging businesses.

Shimankar village is located in Shendam Local Government Area, Plateau State. There is no electricity in the village because it is fully off the grid. The community becomes silent after sunset as work and daily routines cease due to darkness. This has had a particularly negative influence on women and girls who spend the majority of their days doing household tasks. The majority of Shimankar village residents utilise kerosene lanterns and traditional cooking fuels to light their homes.

Through the support of the Rural Electrification Agency, the authors were able to identify the recipients of the solar home system who were involved in the solar mobile phone charging business. To be eligible to participate in this study, women needed to: (a) be eighteen years or older, and (b) own a solar mobile phone charging business. Before the data collection process, the participants were provided with an information sheet and a consent form to sign, and the author also explained the contents to those who lacked the literacy skills to understand the documents. Pseudonyms were used for the participants in order to preserve confidentiality and anonymity. Interview questions were designed using the concepts of Sen's Capability Approach.

During the data collection process, a short survey was administered to gather information on participants' demographics and their ownership of the business. The participants' ages ranged from 30 to 53. Among the respondents, four were in their 50s, five were in their 40s, and seven were in their 30s. All the selected women participated in a face-to-face interview at mostly their place of business. Three of the authors have extensive knowledge of Nigeria and are fluent in the Hausa language used when conducting the interviews, which were all audio-recorded. The interview sessions lasted anything from thirty minutes to an hour, depending on the amount of information required. The data saturation principle was used; after interviewing sixteen women, the process was stopped because no new information could be revealed from additional questioning. The summary of the findings were shared with the participants by the authors and the participants agreed with the findings. This was to provide transparency, ensure the findings were accurate, and to validify the honesty and integrity of the researchers.

A total of 8 hours of interviews with the participants were done. The authors organised, translated, and transcribed 19 pages of interviews. Thematic analysis principles were utilised to evaluate qualitative data. The first step in this approach was to carefully read and re-read the transcribed data in order to find recurring topics discussed by the participants. Following that, transcript data was coded, and the various coded extracts were then grouped into themes. After completing the coding exercises and reviewing the themes by the authors, we produced our report as presented in the case study context and analysis section.

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Case Study Context

Shimankar Community and the Mobile Phone Charging Women Entrepreneurs

Women in Shimankar complained, in a town hall meeting with their political representatives, about the negative impact of lack of electricity on women's empowerment, specifically how it affects the work of traditional birth attendants who assist women in giving birth, as well as how it prevents women from carrying out their daily chores and business activities, which end abruptly due to darkness. In response to community complaints, their political representatives began donating solar home systems to nearly 1900 households in partnership with the Rural Electrification Agency. The rural electricity initiative began in December 2020 with the delivery of solar home systems to selected women in the Shimankar community, with the prospect of expansion and a mini-grid. The chosen women, who were typically farmers, raised maize, tomatoes, and potatoes with the help of their husbands and children. The chosen women were taught how to use solar household systems and start their own businesses. The selected women were trained on how to use solar home systems and how to become entrepreneurs. This includes managing funds, earning a profit, advertising, and keeping track of each transaction. The solar home kit consists of a 50Wp solar PV panel and a 17Ah battery. Following the installation of the SHS, several of the women chose to start phone charging businesses to augment their little farming revenue. In the following section, we used the concepts of Sen's capability approach as pillars for the case study analysis to understand the developmental opportunities associated with the solar mobile phone charging business and its contribution to the lives of the women in the village.

Analysis

Economic and Political Capabilities

Due to a lack of electricity in the community, residents normally pay to charge their phones at these women's homes or shops. A single solar household system can charge up to four phones at once, and the women charge 50 naira for 30 minutes and 100 naira for an hour. The findings of the study showed that the phone charging businesses have provided the women with the freedom to earn money and expand their existing small businesses. Many of the participants said that they had grown their businesses as a result of the money they had made, as shown in the remark below:

> *"In addition to the farming that I do, I've been able to make more money, which I've used to expand the business. I now sell recharge cards as well, and I'm considering purchasing additional SHS to expand the amount of phones I can charge."*

Furthermore, the findings show that apart from economic opportunities, engaging in the business also resulted in political freedoms in terms of participating in political activities of determining who should represent and govern them. The women formed an association of mobile phone charging business owners where they determine the price of charging, and they also make a monthly contribution to the association where they are able to support members with loans to purchase SHS. During the fieldwork, the women had just conducted an election to elect new executives within the association. Setting up the association and being members

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have enabled the women not only economic but also political benefit as mentioned by one of the participants:

> *"Since the formation of this association, we have supported more than 20 women to purchase the solar home system through loans and also due to the status of this organisation and its ability to mobilise women, we have a lot of politicians and stakeholders within the village always reaching out to us with regards to issues that affect women in the village."*

Social Capabilities

The findings of the study showed that women phone charging businesses gained the freedom to learn and education. Also, the ladies were given instruction on by representatives from REon how to become entrepreneurs, who taught them marketing strategies for promoting their businesses, such as placing a written sign in front of their homes. Many of the women believed that the sign post was more essential than word of mouth in terms of advertising because passers-by could easily see and read it. As seen in the quote below, the women also learned about record keeping, which was critical to the success of their business.:

> *"As a farmer, sometimes we sell our farm produce in the market without any record keeping; however, with the training we received when provided with the SHS, I have now learnt how to make note of all my business transactions for the day and also the expenditure and income, I have used this knowledge also for my farming business."*

The women noted that their ability to keep records of their business transactions helps them ensure they do not spend more than they earn and helps them keep track of their profit. Some of the women used profit they made for their business to expand their business by ordering my SHS while others supported family members as shown in the quote below:

> *"With my little earnings, I use some of the money to support my daughter who is unemployed, and a widow with two kids. I bought her the SHS and she now makes some money to help herself and my grandchildren. I don't have to worry about sending money to her all the time as she is now independent."*

Also stated was obtaining some understanding about mobile phones by the participants. Because of the nature of the job, many of them had learned about various phone brands, charger types, and even how to operate them, specifically how to turn on and off customers' phones. One of the participants stated this:

> *"Since I started my phone charging business, I've become familiar with a variety of phone brands, including Itel, Nokia, Infinix, Techno, and others. One client even brought the smartphone (iPhone) of his uncle who came visiting from abroad to charge. I didn't even have the charger for the phone because it's not a popular phone, but the client brought their charger and taught me how to plug it in and turn it off."*

Women's clients were also affected by the mobile phone charging business. The fact that they occasionally enabled their clients whom they knew well to charge their phones on credit demonstrates the importance of maintaining and creating strong community relationships, hence enhancing their freedoms of social relationships. Although another participant declined requests from friends to charge their phones on credit which on the other hand severed the

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relationship between them. Furthermore, the village's mobile phone charging business has prevented many neighbors without power from having to travel to neighboring communities to charge their phones. Travelling to this communities is usually expensive and comes with a high risk of being kidnapped and raped due to the volatile situation in the area, which has recently been attacked by bandits as shown in the quote below:

> *"In the past, most families have to travel at least an hour to the next village to charge their phone and you know that road is very dangerous due to Fulani bandits that have recently started terrorizing commutes on the main road. But with this business now, everyone just pays a little money to charge their phones, which saves them money and risk of kidnappers and also our children, especially the girls, can always be at home to support us after school."*

Conversion Factors

Environmental Factors

Technical

The mobile phone charging business was not without its difficulties for the women. Majority of the participants reported that their SHS was frequently plagued with technical issues, particularly with the battery water and, on rare occasions, the controller, preventing them from charging as many phones as feasible. The battery frequently died quickly after a year of usage, and there were few resources available, such as a technically trained person to repair the defective SHS, as one of the participants explained it:

> *"The problem we have is that the few electricians we have in the village have been unable to repair some of the malfunctioning SHS, and most of the time they tell us to go back to the main supplier. If you go to any electrician's workshop here, at least one of two SHS will be laying around."*

Many of the women claim that they went out of business as a result of the inability to repair their faulty SHS, and that they were unable to afford another SHS, while others had to default on the loan repayment they had taken out with the association. The women's association, on the other hand, has sought to contact the SHS suppliers, but, due to the village's proximity, it usually takes months for the suppliers to send a representative to fetch the SHS in order to repair or replace them. Also, several of the women voiced concern about the high cost of replacing the batteries and noted that they would have preferred to be told of the necessity to start saving for a battery replacement from the start of the project; battery problems were a big concern for SHS from the outset.

Security and Cultural Issues

The issue of security was also brought up by the participants. All of the interviewees stated that they run from their homes or shops. To prevent theft, individuals who ran their businesses from home had their equipment installed in their rooms, while those who ran them from their shops had their equipment installed behind their counters. Despite these safeguards, one of the women stated that there had been multiple attempts at theft, either in their homes or at their business centres, to steal phones or equipment, as shown in the following quote:

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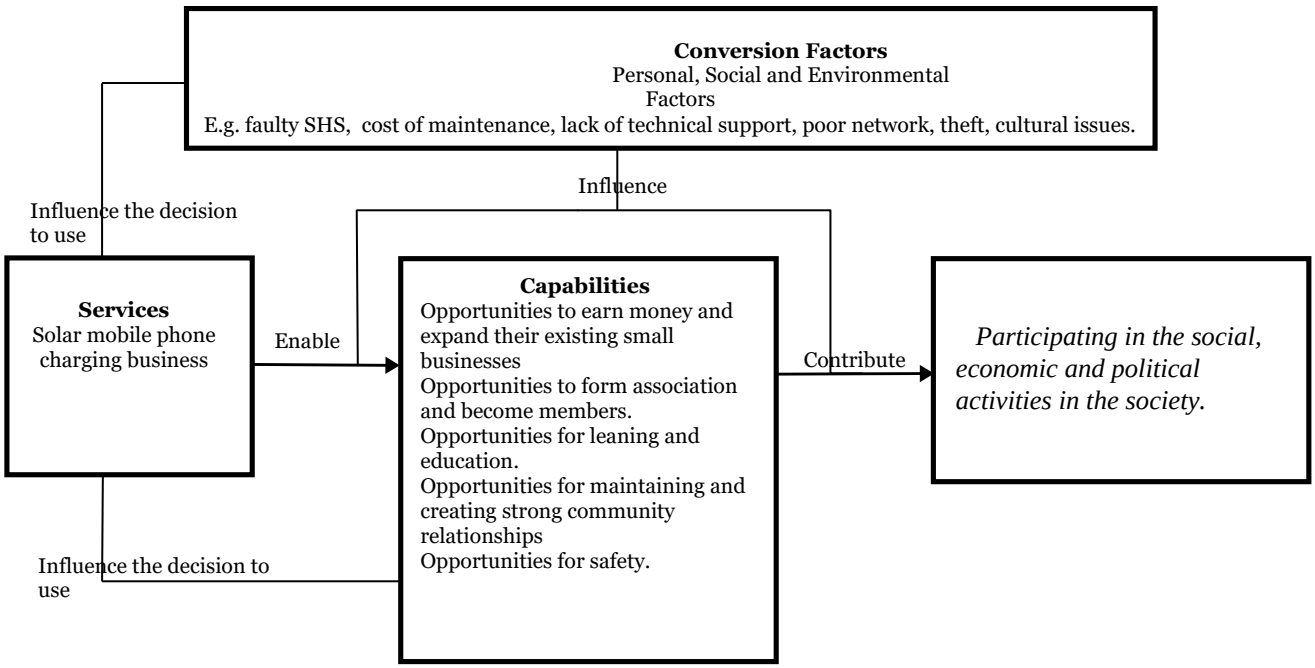
> *"Two weeks after I had started this business, some men came to the house posing as customers who had dropped their phones and were unable to pick their phones during the day. Luckily enough for me that day, I had no customers who left their phones for overnight charging and when they noticed the voice of my husband who immediately asked why they were here in the middle of night, they immediately ran away".*

Another participant who was not lucky enough stated:

> *"In my situation, a customer's phone was taken after two women entered my shop, one of whom distracted my sales girl, and while she was attempting to attend to her, the other lady crept in and snatched nearly three phones off the charging station."*

Because of the high rate of theft, many of the participants stated that they do not accept overnight charging and have taken efforts not to allow more than one person to come for phone collection. Finally, some women report incidents where their husbands have prohibited their wives from continuing the solar phone charging business due to their additional source of income, which allows them to earn more than their husbands and therefore become the family's breadwinners. According to one of the participants, she stated:

> *"My husband has requested that I cease operations as soon as the debt I received from the association has been repaid. He is envious since I now make more than him and support more of the household chores...he feels humiliated by them, especially because he believes the children will no longer respect him because I am now wealthier."*



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DISCUSSION AND CONCLUSION

In this paper, the study examined the development opportunities provided to women due to their involvement in the solar mobile phone charging business. The study was informed by Sen's Capability Approach to development, which shows how the solar mobile phone charging businesses provided rural women with opportunities in social, economic, and political activities of the society. The findings showed that income generation and expansion of business are economic capabilities. This reflects the findings of other studies in ICT4D that show that ICT4D and its ancillary services empower women economically (Murphy & Priebe, 2011; Divall et al., 2021). Also, the study's findings showed that the solar mobile phone charging business provided women with the opportunities to gain education benefits. Many of the women learned how to run a business and become entrepreneurs and new knowledge of mobile phones. This is similar to the other studies on ICT4D conducted by women (Crittenden, Crittenden & Ajjan, 2019; Hashim, Razak & Amir, 2011). Lastly, the presence of the solar mobile phone charging business opportunities for safety and social connections. In particular, the business helped women build and maintain existing relationships with other villagers who also served as customers.

Interestingly, the findings of our study found evidence of collective capabilities. We identified the opportunities to participate in political activities. The findings showed that the women were able to set up an association for the women running solar mobile phone charging business in which they held elections to select their leaders and were also able to push for the agenda of women in the political space of the community. Developing these collective capabilities necessitates the exercise of individual liberty in pursuit of these objectives and involvement in a collectivity (Ibrahim, 2006).

However, the findings of our study further showed that the ability of women to utilize the opportunities offered by the solar phone mobile charging business was contingent on primarily environmental factors, namely technical and security issues. Firstly, technical challenges, cost of maintenance, and lack of support for the solar home systems hindered the women in successfully running the business. The results are consistent with other studies that showed that poor quality solar home systems, technical capability and affordability hinder users from attaining the benefits of solar home systems (Mondal & Klein, 2011). Also, patriarchy and criminal activities, such as theft, impede the developmental opportunities associated with the mobile phone charging business. This is common in some African societies where men dominate women and the high rate of poverty and employment in Nigeria, which has resulted in the rise of criminal activities within the country (Dasuki & Effah, 2021).

In sum, we have shown that women were able to generate both individual and collective capabilities to improve their lives as a result of their involvement in the solar mobile phone charging business. However, the generation of these capabilities was dependent on conversion factors. The study contributes to theory by extending the application of CA from solely focusing on individual capabilities to including collective capabilities. The findings also have some implications for practice. The solar mobile phone charging business does have the potential to contribute to the lives of women in Nigeria; however, in order to make most of it, the policy makers and donors should ensure high-quality SHS are provided and appropriate support service is required to ensure their sustained functionality which in turn contributes to supporting women involved in the solar mobile charging business.

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In suggesting the potential for future research, the limitation of this study is recognized. The study was limited in that only a single focused case study was undertaken under severe time limitations. There is a scope for a longitudinal study with a bigger sample size. The findings of the study cannot be generalised; however, the concepts can be developed further and explored in similar research settings.

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SAND MINING: ECONOMIC GAINS, ENVIRONMENTAL ETHICS, AND POLICY IMPLICATIONS

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ABSTRACT: *Sand mining which been a major contributor to economic growth and development has turned out to be a source of environmental degradation based on the fact that the renewal rate of sand is lower than its rate of consumption. This study reviewed the universe, earth, and finally focused on sand as one of earth's most consumed natural resources after water. The study shows how countries of the world engage in sand exportation to grow their economy by creating job opportunities to both skilled and unskilled individuals in the society. Key issues surrounding the ethical conduct of sand mining were discussed in details by angling towards environmentalists' view that are of the opinion that sand mining activities ought to be drastically reduced and strictly regulated in order to save the depleted state of the ecosystem. The study was anchored on the Green theory which emphasizes that there is a need to regulate the overconsumption of shared natural resources such as land, water, and sea animals by individuals and organizations.*

KEYWORDS: Aggregate Mining, Environmental Ethics, Environment Programme, Natural Resources, United Nations.

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INTRODUCTION

The Universe consists of Planet Earth and all its living organisms, as well as the moon, stars, sun, and all other known and unknown planets (William, 2017). Scientists and philosophers from time past seem to be in obscurity regarding the cosmology and cosmogony of the universe; that which relates to the universe's origin and structure respectively. Overtime, scientists have made several attempts to explain the origin of the universe through known theories such as the Big Bang theory, the Steady State theory, and the Oscillating Universe theory (Williams, 2017).

Earth been one of the planets that orbits around a 4.5 billion year old medium sized star called the Sun, takes approximately 365.26 days to make one rotation as it continuously spin around its axis once every 23.93 hours (Anthony, 2009). Alongside planet Earth, Mercury which has a close proximity to the Sun, Venus, Earth, and Mars sum up a group known as the *"terrestrial planets"*, out of which Earth is the largest, the greatly dense, and is uniquely distinct as the only planet where water exists not only as a surface liquid, but also as solid and gas (Anthony, 2009); and is endowed with natural resources which can be classified as renewable and non-renewable resources. While renewable resources are resources that can naturally be replenished because its recovery rate exceeds the rate of its consumption, non-renewable resources on the other hand are resources that have its recovery rate lower than its consumption rate (Rinkesh, 2020).

Earth's natural resources include energy resources, non metallic resources, metallic resources, water, air, animals, and natural vegetations (South Carolina Geological Survey, 2005). The subcategories of these broader resources include for Energy resources petroleum products like oil, natural gas, coal, uranium, and other alternative energies such as wind, tidal, and solar. Non-metallic are rocks and soil, and finally for metallic resources there are iron, copper, aluminum, lead, zinc, gold, silver and many others (South Carolina Geological Survey, 2005). Still for the purpose of this study, we shall narrow down to sand which is a type of soil. There is an utmost need to untangle the complexity of differentiating sand from soil. Soil on one hand has pores which permits it to hold water and nutrients, while sand on the other hand, is grainy loose without the presence of pores for neither holding water nor nutrients (Diksha, 2015).

Mining of sand has been an activity that is as old as anyone can remember as in various periods and time, people and organizations have always utilized sand in one way or another either in the building of houses, construction of bridges, roads , making of glasses or in other things that can be made out of it. In-spite of its usefulness, there is an outcry regarding its renewal rate which is far below its rate of consumption. Environmentalists' have constantly warned that aggregate mining is endangering earth's ecosystem and lives of underwater species, and also threatens the longevity of infrastructural facilities especially those erected on water. This is a difficult situation to handle as naturally sand-endowed countries are involved in the exportation of sand to countries that demands it thereby contributing positively to the exporting countries gross domestic product and overall economic growth rate.

The problem therefore lies in either to adhere to environmentalist warning by halting or reducing the rate of sand mining thereby reducing GDP of countries or to continue with sand mining activities which increase countries GDP and create employment opportunities.

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Aggregate Mining

Aggregate mining which entails both sand mining and gravel extraction is a daily global activity witnessed in both developed and developing countries (Draggan, 2008). Globally, out of the 59 billion tonnes of material mined yearly (Steinberger, Krausman & Eisenmenger, 2010), aggregate mining accounts for about 68% to 85% making it the fastest extraction (Krausmann, Gingrich, Eisenmenger, Haber & Fischer-kowalski, 2009). Sand is a heavy grainy resource that consists of tiny pieces of rocks and minerals that form in water channels such as rivers and beaches, and also can be seen in deserts (Tariro, 2013). Sand is a material identified as having loose, gritty particles of disintegrated rock that are often deposited along shores of water bodies, in river beds, or desert dunes (Shaffer, 2006). Even more concisely, Atejioye and Odeyemi (2018) perceived sand to be an underground geological resource formed from eroded mountain rocks carried by streams and rivers. One can draw inference from the above definitions by saying that sand is first a natural resource that is loose in appearance, and emanates from loose rocks and can be seen along/in shores, in water channels.

The importance of sand as a natural resource is given by the fact that, after fresh water, sand is seen as the next most consumed natural resource on this planet (Villioth, 2014). Sand accounts for one of the largest amount of natural material extracted globally (Peduzzi, 2014). In sharp agreement, United Nations Environment Programme (2014) asserts that sand and gravel are the widely used natural resources only next to water.

A major way to analyse global aggregate utilization is to examine the production of cement for concrete which is made using cement, water, sand and gravel (United Nation Environment Programme, 2014). Countries production of cement reached a staggering figure of 3.7 billion tonnes in 2012 (USGS, 2013a), and for each tone of produced cement, construction industry requires more than 7 tonnes of sand and gravel, which makes the world's use of aggregate in 2012 to be around 29.6 billion (USGS, 2013b), a figure that is enough to build a concrete wall of about 27 metres high and 27 metres wide round the equator (UNEP, 2014). This excessive rise in the demand of sand whose primary aim is to facilitate economic activities is on one hand generating revenue and profit for government and companies respectively, while on the other hand, is a major cause of serious environmental issue owing to these facts: that its renewal rate is far below its consumption rate, and that it impacts negatively on the environment. Environmental concerns occur when extraction rate of sand exceeds the natural renewal processes of sand generation (Mattamana, Varghese & Kichu, 2013). The increasing request for sand can be linked to its importance and role in construction and other uses which currently make it indispensable (Kori, & Mthanda, 2012). Sand is a key developmental component utilized in the modern world (Tayler, 2018) which is employed in the production of outputs ranging from concrete to glass to asphalt to electronics, and also is central to man's daily economic activities (Delestrac, 2013). Sand is utilized in the construction of projects with both economic and social value such as land reclamation, construction of artificial islands and coastline stabilization. These however are not without environmental consequences (Ashraf, Maah,Yusoff, Wadij & Mahmood, 2011). This multidimensional use of sand has given rise to an exponential consumption rate and this trend is expected to continue due to population growth and increased demand for improved standard of living (Gavriletea, 2017). Considering the fact that deserts cover almost 20% of Earth's land surface and 20–30% of the world's deserts are covered by sand (Harris, 2003), one may erroneously conclude that this thus meets the

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demand for sand. This is an incorrect assertion because desert sands have continuously failed to meet industry required standard (Gavriletea, 2017), because wind erosion in deserts makes it difficult for sand grains to bind together (Zhao, Li, Zhuo, Guo, Liao, & Xie, 2014).

Nurhasan and Saputra (2018) described mining as involving the extraction of valuable minerals and/or other geological materials from the earth, usually from an ore body, lode, vein, seam, and reef or placer deposit; with these deposits forming mineralized package that is economically beneficial to miners (Amir, 2016). Sand extraction is a worldwide activity in both developed and developing countries as was realised by Draggan (2008). Sand and associated sediments mining is the removal, excavation, extraction, quarrying or dredging of sand, gravel, rocks, boulders and other deposits from the bed, bank, or floodplain of a river, or from a river reserve (Environmental Conservation Department, 2000). From environmentalist perspective, Saviour and Stalin (2012) simply defined sand mining as the process of extracting sand and gravel at a level that makes it become an environmental issue. This therefore means that the process of removing sand from its natural configuration is referred to as sand mining (Ashraf, Maah,Yusoff, Wadij & Mahmood, 2011). Sand deposits can either be based terrestrially or in marine (Gelabert, 2016). Terrestrial sources include residual soil deposits, river channel deposits and floodplain alluvial deposits, with the most common marine sources being shore and offshore deposits (Gelabert, 2016). According to Kowalska and Sobczyk (2014), sand deposits are located in the majority of areas on the mountain and river valleys which are often environmentally valuable regions. Being expensive than terrestrial exploitation, developed economies utterly involved in offshore dredging as a result of the cost of specialized equipment and special environmental permits required (Pereira, 2016). The Environmental Conservation Department (2000) identified three methods of extraction in relation to sand mining which are; Mechanical method that pertains to the use of construction machinery such as excavator, backhoe, bulldozer; Hydraulic dredging involving specially built equipment to dredge sand, either by excavation, dragging or suction; and finally, Manual method that involves the use of manpower with hand shovel, scoop". Globally, sand mining is mainly carried out on rivers and associated environments where excavation equipments are readily available (Gurubachan, Meht, Sharma, Chawla, Joshi, & Yaduvanchi, 2005). Atejioye and Odeyemi (2018) note that as large scale excavation may require heavy equipment or rubber-tired front-end loaders, small-scale terrestrial sand miner in Nigeria, excavate and load mined sand on trucks by hiring labourers that make use of shovels. According to Greory (2017), before sand get to buyers, it goes through these processes; first is to extract sand either from pit or underwater using suction pipe to suck the sand; secondly, the extracted sand is being transferred into a truck and conveyed to the processing facility; thirdly, the extracted sand will undergo a sorting process where it will be mixed with water into a slurry' fourthly, the mixed sand will be thoroughly washed and the sand that settles at the bottom of the slurry will pumped out and crushed into desired shape; and finally, the processed sand will be transported to the demand location either through trucks or boats which solely depends on the delivery location. Sand mining to a large extent has contributed immensely to the growth of countries over the years; this therefore means that there are significant economic gains associated with sand mining. The diagram below shows the classification of sand comprising its method of formation, composition, and the distribution of grain size.

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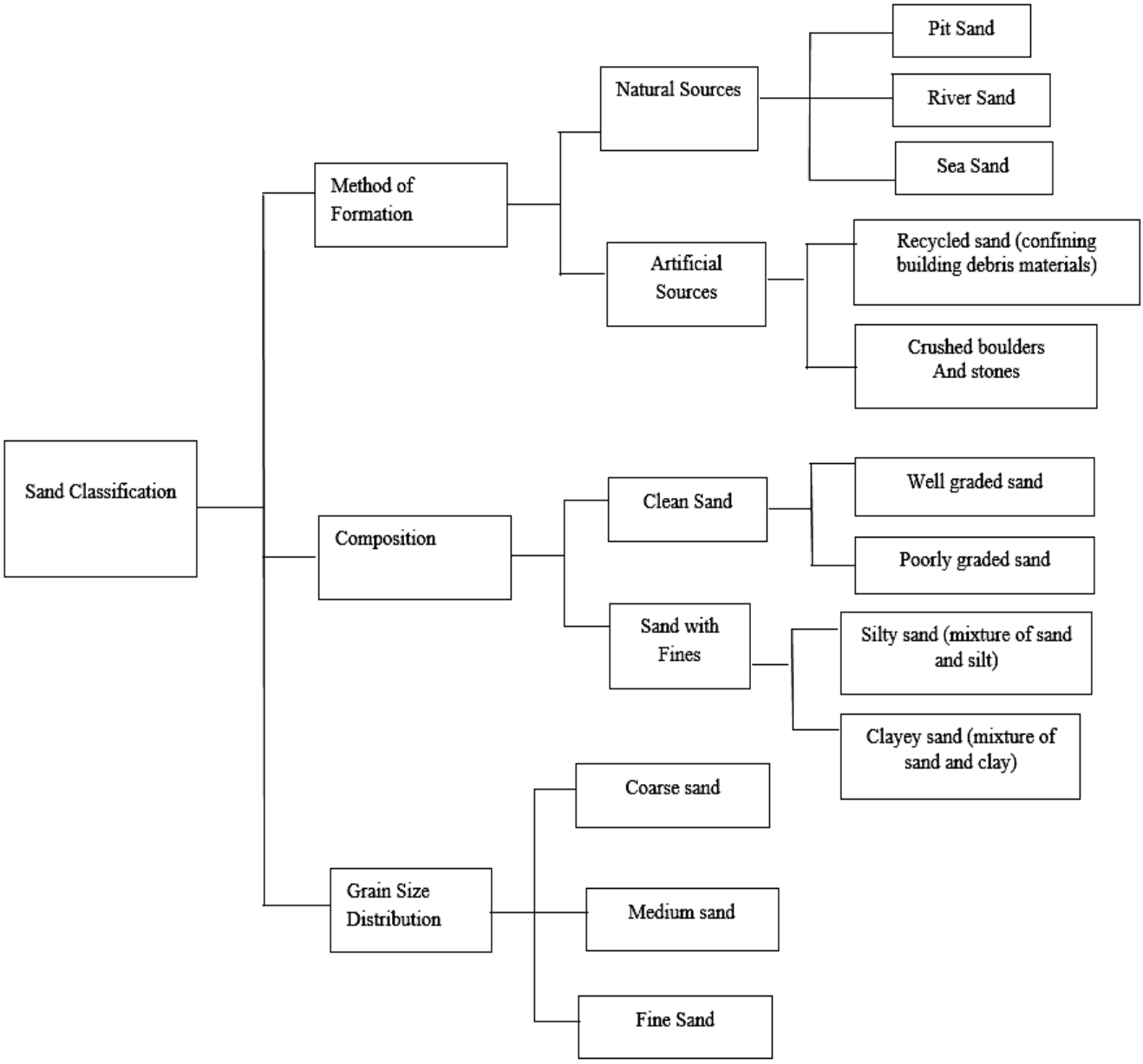

Figure 1: Classification of sand, adopted from Gavriletea, (2017).

Economic Gains of Aggregate Mining (Sand and Gravel)

Over the years, economists in their long debated arguments have all suggested how best to create and sustain economic stability in regard to national income or output, full employment, and probably the control of inflation and deflation both in the short and long run. From our basic knowledge of economics, recall that in the national flow of income in a two sector economy, the two key players are the household and the business firms. We thus know that the sum of the household's consumption and the business firm's investment gives us a numerical value which we equate as our aggregate expenditure or aggregate demand within a

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given period. Our focus however will be on consumption and investment demand as they contribute to national income corresponding to full employment by singling out the contribution of sand mining to the Gross Domestic Product of countries.

A positively skewed economic growth being the bedrock of long-term sustainability is an indicator that human development, social welfare, employment, purchase power and productive capacity are all moving progressively in line with the growth plan of an economy (Łukasz, 2014; Kemal, Hale & Husam, 2020). The two main contributors to the neoclassical growth theory are Robert Solow and J.E Meade. According to Gabriel (2018), the neoclassical theory maintained that independence decision-making should be encouraged with little or no interference from government. The tenet of this theory rests on being able to shape economic activities only when the role of government has been reduced intensely. He further explained that in relation to the neoclassical theory, the category that gets wealthy do so by hard-work and frugality while those who become poor do so by profligacy and laziness. According to Supriya (2014), neoclassical growth theory laid emphasis on; firstly, capital accumulation as an important determinant of economic growth. Secondly, the amount of available unskilled labour, and thirdly, the utilization of technology which is likely increase labour productivity. One would then wonder, if government is encouraged to limit its involvement in the economic activities; who then regulates the over-bearing powers of most private investors. The global demand for sand utilization has leaned towards the natural law of demand which states that as the demand for a commodity increases, its corresponding price is likely to increase; this has consequently caused the price and demand for sand increase.

Due to the abundant availability of sand, rural dwellers have been able to upgrade themselves economically which are evident in the erection of strong durable building for their inhabitation (Madyise, 2013); the creation of employment for both youths and adults who are utilized as loaders that move sand to dispatch trucks (Sada & Shestha, 2013); as well as improving the quality of road networks (Mngeni, Musampa & Nakin, 2016). Being a developing country, Singapore is rapidly developing infrastructural facilities to meet up with its population which grew from 1.63 million in 1960's to 4.84 million in 2010 (UNEP, 2014), so is growing their need to import sand for the construct of infrastructures. Also, bearing in mind that Singapore is a small country; their need for space has made them utilize most aggregates in reclaiming land from the sea needed for infrastructures thereby increasing its land space at about 20% in about four decades (Aquaknow, 2014). Singapore's importation of 517 million tonnes of sand in the last 20 years makes them the world's top ranked importers of sand (UN Comtrade, 2014); excluding alleged illegal sand trade (Global Witness, 2010).

The human population on earth as at 2011 was estimated to be around seven billion, and even till now, there is a continuous global population growth (Gavriletea, 2017). According to the United Nations Department of Economic and Social Affairs Population Division (2014), about 54% of the global population dwell in urban cities and is expected to rise to 66% by 2050. This continuous growth in population will increase the global aggregate demand for houses therefore putting pressure on governments and construction companies to tackle the problem of accommodation (Gavriletea, 2017).

Having this in mind, it should also be noted that concrete being the core material used in construction (BCET Staff, 2016) is invariably making the demand of sand and gravels

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explode (UNEP, 2014). The value of sand and gravel imported by Qatar as at 2012 stood at $6.5B (Schoof, 2014), which makes them the highest importers of sand at that particular period (Gavriletea, 2017). Also within same year, United Arab Emirate import value of sand, stone and gravel was $456M (Churchill, 2016), and China alone constructed 146,400 kilometers of road in a year (EDE, 2013) which is an indicator of global demand for aggregates. Dubai City in United Arab Emirates is among the few cities in the world with stunning architectural piece which implies that huge amounts of tension have been laid on marine aggregate for the erection of such master class (UNEP, 2014). The construction of Palm Jumeirah an artificial island in Dubai required 186.5 million cubic metres of sand and 10 million cubic metres of rock costs a stunning US $12 billion (Jan De Nul group, 2013). United Arab Emirate having exhausted its marine sand had to import sand from Australia for the construction of projects such the Burj Khalifa tower which is 828 meters making it the tallest building in the world (Delestrac, 2013).

Analytically, we shall examine the top global exporters of sand in 2019, top 5 importers of sand in 2019, countries with highest import tariffs, countries with highest export tariffs, fastest growing sand exporting countries, and fastest growing sand importing countries in tables and graphs.

Table 1: Top 15 Sand Exporters by countries in 2019

S/N	Countries	Export Value (Million Dollars)	Percentage Rate (%)
1.	United States	461.3	27.7
2.	Netherlands	225.6	13.5
3.	Germany	133.4	8.0
4.	Belgium	120	7.2
5.	Australia	97.9	5.9
6.	France	53.8	3.2
7.	Egypt	41.6	2.5
8.	Saudi Arabia	38.6	2.3
9.	Taiwan	36.6	2.2
10.	Malaysia	32.3	1.9
11.	Vietnam	30.5	1.8
12.	Canada	28.4	1.7
13.	Mozambique	25.4	1.5
14.	United Kingdom	23.3	1.4
15.	Portugal	22.9	1.4

Source: Adapted from Workman (2021).

Table 1 above shows the value of exported sand and its associated percentage rate as performed by fifteen (15) countries in 2019. United States of America is the highest exporters of sand with an export value o 461.3 million dollars representing about 27.7% of global export. Portugal on the fifteenth position had an export value of 22.9 million dollars representing a value of 1.4% of the world's global export.

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Table 2: Sand Exports made by continents in 2019

S/N	Continents	Export Value (Million Dollars)	Percentage Rate (%) (Global Export Rate)
1.	Europe	579	34.7
2.	North America	489.7	29.4
3.	Asia	138	8.2
4.	Australia	97.9	5.9
5.	Africa	67	4.0

Source: Researcher's conceptualization (2021)

In terms of the contribution of continents to global sand exports, the key continents are; Europe, North America, Asia, and Africa. The first placed continent is Europe with participating countries including; Netherland, Germany, Belgium, France, United Kingdom, and Portugal with a cumulative export value of 579 million dollars with a percentage rate of 34.7% of global export rate. The second placed continent is North America where only United State and Canada made the top 15 global exporters of sand with a dollar value of 489.7 million dollars with a percentage rate of 29.4% of the global export rate. The third placed continent is Asia where key participants are Saudi Arabia, Taiwan, Malaysia, and Vietnam with a dollar value of 138 million dollars at a percentage rate of 8.2% of the global export rate. The forth continent on the list is Australia with a value of 97.9 million dollars representing 5.9% of global export rate. Finally, Africa had just two representatives in Egypt and Mozambique with dollar value of 67 million dollars representing 4.0% of global export rate.

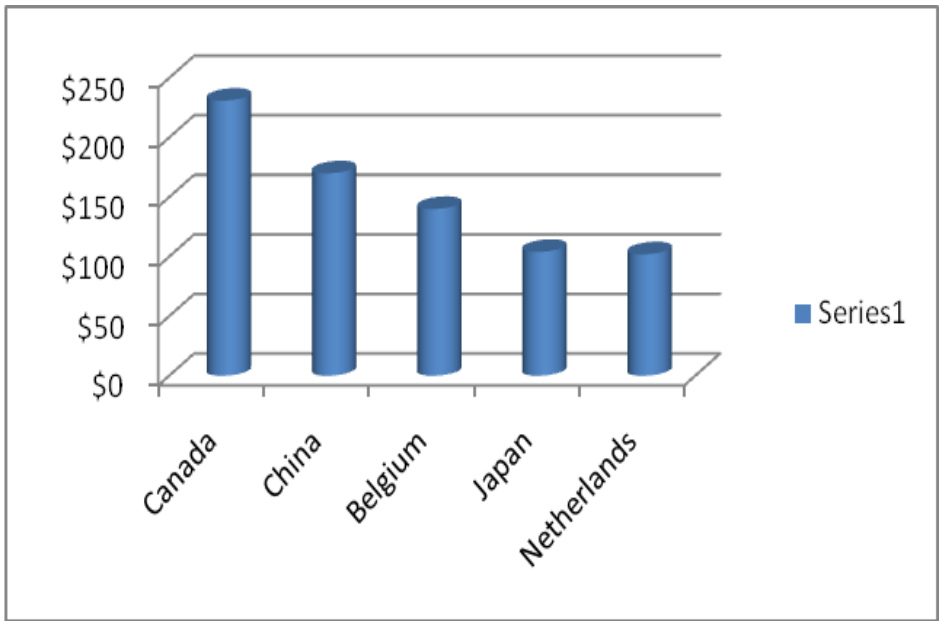

Figure 2: OEC Sand Importation by Countries, 2021

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The Graph above shows the value of sand importation made by five Countries. Globally, Canada is the highest importers of sand with a value of about $231 million, with China second in rank with an import value of $170 million, while Belgium, Japan, and Netherland are the other countries that make up the top five with values of $140 million, $104 million, and $102 million respectively.

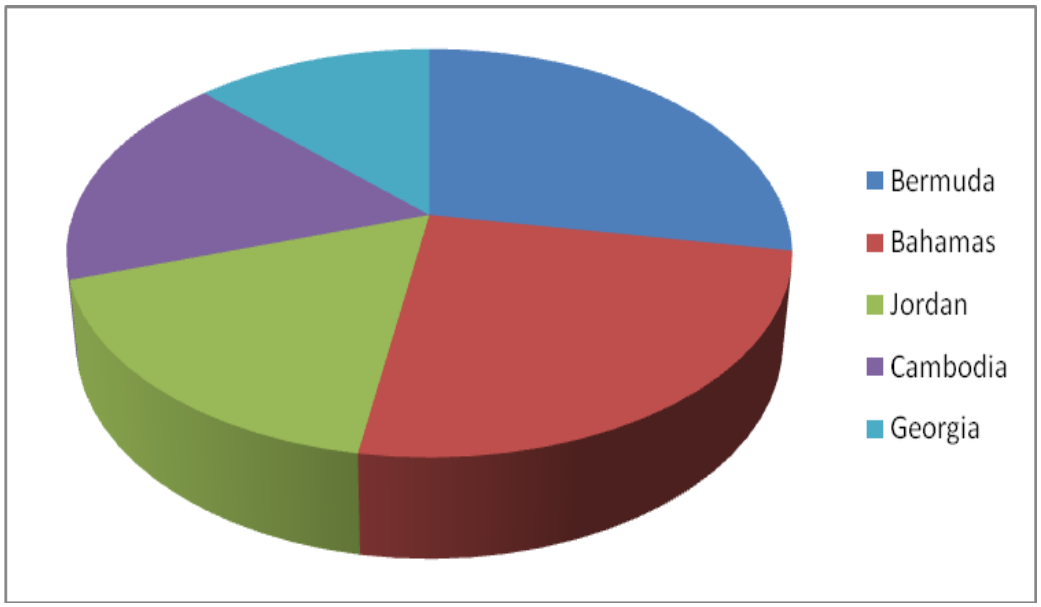

Figure 3: OEC Sand Importation Tariff, 2021

The chart above represents the countries with the highest rate of tariff imposed on the importation of sand. Worldwide, Bermuda is the country that places high tariff on the importation of sand, with a percentage rate of 25%, while Bahamas, Jordan, Cambodia, and Georgia have their rate at 22.3%, 15.6%, 15%, and 11.4% respectively. However, countries like Angola, Kenya, Mauritius, Rwanda, and Tanzania all have zero tariffs on the importation of sand.

According to the Observatory of Economic Complexity (2019), between 2018 and 2019, there seems to be a tremendous growth in the export and import of sand; "the fastest growing exporting countries and their values include; Philippine ($21.6m), Oman ($20m), Myanmar ($11.5m), Australia ($11.4m), and Vietnam ($7.29m); while the fastest growing importing countries are Hong Kong, United Arab Emirates, Chinese Taipei, Turkey, and Iran with import value of $34.2m, $15.9m, $5.56m, $5.54m, and $3.39m respectively".

In-spite of the tremendous contribution of sand mining to the economic development of countries, it is not without environmental challenges as environmentalists more than ever are speaking up as regards the danger of sand mining. This will be discussed in details in the subsequent section.

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Environmental - Ethical Issues in Sand Mining

Ethics pertains to the analysis of what is good or bad and what can be termed as a right or wrong behaviour which usually occurs in the framework of making ends meet (Tota & Shehu, 2012).

More differently, the utilitarianism ethical theory which is a form of consequentialism determines right from wrong by focusing on outcomes (McCombs Business School, 2021). Utilitarian theory emphasizes on the greatest good for the greater number of people (Gareth, 2000). However, a major limitation in this theory rests on the fact that since the future cannot be predicted, it then makes it difficult to tell if the consequences of an action will be good or bad (McCombs Business school, 2021). However, in sharp contrast to the neoclassical theory which advocates a capitalist economic system where private individuals rather than governments determine the production and distribution of goods and services; also states that there should be less government interference in economic activities, Siam (2018) explained that the constraints of capitalism on the basis of ethics are inequality and waste. *Inequality* in capitalism does not in any way promote equality of opportunities. Individuals who do not have the necessary support needed may never make it to the top. The idea that "if you work hard enough you will get rich" is a fallacy. *Waste* in a capitalist society where there is uneven distribution of resources, waste is inevitable. Whenever these excess resources do not find their way to the poor, the tendency of being wasted will be extremely very high.

From the researchers' observation global hardship seems to have ushered an era characterised by abandonment of code of ethics as individuals, groups, and organizations have swayed form approved behaviour towards embracing unethical practices which heightened unemployment is a key contributing factor. Economists over the years have continued in their stead of achieving economic stability both in the short and long run rather than paying attention to environmentalist cry of economic morality. Tota and Shehu (2012) opined that economists' understanding of ethics will adequately improve the quality of their policy formation, implementation, and evaluation since they have a good knowledge of what informs individuals moral behaviour.

In the global mining of sand, there seems to be varying opinion as regards its positive and negative environment impact as well as its positive and negative impact on an economy. The argument exists between environmentalists on one side, and economists on the other side. This thus gives rises to the concept of ethical dilemma; which refers to the complexity of situation an individual or business is faced with, which urgently requires that a decision be made in regard to an action (Harrison, 2005). A dilemma may arise from the conflict between the rightness and wrongness of an action as well as how good or bad the consequence of the actions turns out to be (Tota & Shehu, 2012). From environmentalists' perspective, as given by UNEP (1992), "continuous mining of sand is lowering the productive capacity of land either temporary or permanently". While from an economist point of view, sand mining has been a key source of employment creation for both urban and rural dwellers which is contributing immensely to the gross national product of countries.

Tayler (2018) warned that sand mining has negative significant ecological and social impact on an environment. In terms of the ecological impact of sand mining to an environment, Mingist and Gebremedhin (2016) reveal that aggregate mining had a number of negative impacts on local fish populations when spawning surface are destroyed, continuously altering

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the escape routes of large fishes, thereby being the cause of large scale fish being killed. Aggregate Fish are usually threatened by suction dredging pipes during their embryonic stages (Harvey & Lisle, 1998). For instance, an endangered crocodile was found in Asian river systems which mean that of sand mining is destroying sand banks where these animals bask (Torres, Liu, Brandt & Lear, 2017). Arguably, Rempel and Church (2009) conducted an experiment in the Fraser River, British Columbia, Canada, to discover that there was no threatening impact on local fish community. They also revealed that the temporal experimental mining altered both the abundance and diversity of invertebrates, after which the experimented region was restored to normal thereby ensuring that the mined area disappeared after a flood event (Tayler, 2018).

Aggregate mining does not only affect ecology of rivers but also the community within the river catchment as it causes concern for the state of infrastructures, availability and quality of groundwater, and the continuous eroding of productive land (Tayler, 2018). Mining activities conducted on rivers are seriously threatening the longevity of bridges in particular, which is evident in the observation of Ming-wang, Jyh-Jong, Yii-Wen and Meng-Hsiung (2014) when they reported that four of the five failed bridges in Bachang River Taiwan failed as a result of high rate of sandstone and sand mining extraction. Also, in certain regions, underwater cables and gas-lines have been terribly exposed due to aggregate mining activities (Rinaldi,Wyżga & Surian, 2005), thereby endangering the lives of people. The continuous extraction of gravel and sand (aggregate mining) has been linked to flooding in Nogalte Stream, Spain (Ortega-Becerril, Garzon, Bejar-Pizarro, & Martinez-Diaz, 2016) and the increased risk of flood in Poyang Lake in China (Nakayama & Shankman, 2013).

In regards to groundwater availability and quality, as water levels continue to deplete, wells may cease to give out water to users (Kondolf, 1993; Rinaldi, et al., 2005) and is likely to hamper or limit the water usage needed in for human consumption, agricultural activities, and gross economic setback.

Owing to the fact that sand is probably everywhere, individuals, groups, and communities are on daily basis getting involved in its mining both legally and illegally paying less or no attention to its environmental repercussion (Draggan, 2008); which now leads us to scrutinizing the global operations of sand mafias. Sand mafias operate globally, as they are involved in the mining and exchange of sand for monetary rewards in avenues that have negative impact on the social, environmental, and economic configuration of a country (Khan, 2020).

The sand industry is a multi billion industry with a staggering figure of about USD 60 billion (Khan, 2020). Technically, this industry alone is far richer monetarily than some countries due to the growing nature of these industries. Tweedie (2018) explained that construction companies as much as possible avoid purchasing expensive sand from licensed miners thereby engaging in illegal activities such as going to a remote area and blasting their sand, or suck up marine sand with suction pipe or more extremely they can steal away beach and dismantle an entire island with the help of sand mafias.

Sand Mafias have their activities running from Jamaica to Morocco to India and Indonesia as they continuously destroy habitats, make away with virtually all the sand in beaches in just a single night as they render farming portions and fishing ground unpleasant, and even threaten environmentalists, investigative journalists and even more extremely, honest security agents

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are often inflicted with life threatening injuries and death (Khan, 2020). In a small village in Jamaica, the villagers reported to the authority that on a particular night, a group of people that are fully armed with guns came with trucks and stole their beach away right in front of them (Fritts, 2019). Yearly in Morocco, about 10 million cubic meters of sand supplied are all traced to illegal coastal sand mining (Au fait, 2011) where sand smugglers degraded a large beach to become a rocky landscape between Safi and Essouira (Economiste, 2005; Khardijamal, 2011). Sands extracted from beaches are usually used in building hotels, roads, and other tourism – related infrastructure (UNEP, 2014). Pegged among the most dangerous and influential criminal organizations in India, the "sand mafias", consists of individuals who control both construction firms and administration through their political affiliations, making them an impenetrable organized crime groups in India (Aiyar, 2013; Delestrac, 2013). This group is responsible for a number of deaths in India ranging from government officials, policemen, and to the least, ordinary people who speak in favour of halting and dismembering their activities (Beiser, 2018).

One major economic consequence of the sand mafia's activities is depletion of natural resources, resulting in much agricultural land becoming uncultivable (Khan, 2020). This invariably makes it cumbersome for farmers to earn a living from occupation (Torres et al., 2017; ABC News Australia, 2017), and as a consequence, the immediate economy suffers (Khan, 2020). Another critical economic impact of sand mining is that sand mafias' wherever they domicile usually employ more people than the government or other privates investor are currently doing, thereby breeding a corrupt group system that covers-up sand theft and other social disturbances (Khan, 2020).

From 1995 to 2001, the monetary value of sand imported by Singapore was USD 3.00 per tonne, but this increased to USD190 per tonne between 2003 to 2005 (UN Comtrade, 2014) thereby making it a lucrative business for local sand mafias (Global Witness, 2010), which explains part of the disappearance of sand Islands in Indonesia. Export of sand to Singapore was reported to be responsible for the disappearance of some 24 Indonesian sand islands which triggered political tensions regarding maritime borders between the Singapore and Indonesia (New York Times, 2010; Guerin, 2003) as this was followed by a decline and temporary ban on sand exportation to Singapore in 2002 (Guerin, 2003). This disappearance was as a result of the increase in the price of sand going to Singapore.

Also, it is painful to note that the City of Dubai having exhausted so much sand to construct projects, it was observed that about 31 percent of office space was vacant in the centre of Dubai (Jones, 2013); this means that the economic impact was not duly ascertained. Other palm projects like The Palm Jebel Ali and The World islands project which cost US $14 billion to construct and required 450 million tonnes of sand with only a few of these islands currently hosting infrastructures having exhausted marine sand resources in land reclamation projects (Delestrac, 2013).

Amalie (2020) shared the following experiences of the African countries he visited which are Ghana, Kenya, and Benin Republic. Starting with Ghana, he reported that the coastal regions in Ghana have been deserted as there was no swimming and other beach activity which is a result of beach sand mining and as a consequence made the beach rocky and unkempt. In kemboi sand mine in Kenya, children meant to be school are forced by either their parents or guardians to miss classes and work at sand site to load sand into trucks to enable them raise money for the purchase of school items. Finally in the Republic of Benin, it was reported that

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the main diggers of sand are women and youths who earn around USD87 to USD125 per truckload which makes earn higher than the average salary workers in the country. This implies that more people are likely to engage in sand mining as a result of the attractiveness of pay.

Elsewhere from the Western part of Nigeria, Adedeji, Adebayo and Sotayo (2014) reported that aside the negative environmental impact of sand mining, other infrastructures like roads, water and electricity are constantly damaged by illegal sand miners. They reported that in Lusada area of Ado- Odo/Ota LGA, electricity poles are frequently knocked down by illegal miners and recklessly abandoned regardless of the blackout which will be experienced by electricity users. Also they warned that in Shagamu, the base of electricity substation had been extracted thereby exposing the whole area to erosion. More worrisome is the fact that these illegal miners have removed the base sand of high-tension wire.

From this brief review, the ethical dilemma that still exists is hinged on whether neither to tilt towards the side of the environmentalists that are a seriously speaking up on the dangers that surround unregulated aggregate mining nor to stand with the economists that have been emphasizing on maintaining economic stability and not preaching economic morality.

Theoretical foundation of aggregate mining and environmental sustainability

In the 1960s, there was as an outcry from the public as a result of the excessive activities of self-interested individuals and organizations who were overusing shared resources such as land, water, and fish without considering their rate of replacement (Dyer, 2018). As regard the issue of resource overuse, a Green United Nations conference was held in 1070s aimed towards explaining and understanding the political behaviour behind individual and organizational utilization of shared resources. The outcome of this conference brought about the emergence of the Green theory which firmly serves as the theoretical underpinning of this study. This Green theory can also be described as green political theory, or ecologism, or environmentalism or ecological political theory or environmental political theory (Barry & Dobson, 2003). Green political theory focuses on issues with political and philosophical background existing among human and non-living entities, animals' moral importance, and the role of ethics in restricting harmful political behaviours and the aftermath of technological innovation on the entire environment (Barry, 2013). It also considers the economic and political impact of climate change, overconsumption of natural resources, and the levels of global inequalities (Barry, 2013).

Before the introduction of Green theory, there has been a huge contest between liberalism and environmentalism in regard to the well being of the environment. While liberalism focuses on human right regarding choice and consumption and not concerned with the implication of man's consumption, environmentalism on the hand seeks the establishment of practical structures that identifies environmental issues by attempting to make room for policies that protect the environment from abuse (Dyer, 2018).

Green theory is characterized by radical changes as it continuously challenges recent political, social, and economic structures which give backing to liberalism regarding the environment as it transcends beyond environmentalism and political agency. Green morality emphasized on the need to curtail human material procurement by preserving the interest of non-human environment, this however restricts man's right to consume as much as required

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(Dyer, 2018). Green theory is centered on strict moral vision which promotes green theory of value that is independent of political theories (Goodin, 1992).

As regard the implication of excessive consumption and abuse of aggregate extraction, Green theory is a better fit in explaining and understanding the repercussion of economic and political actions and intentions. Both legal and illegal aggregate extraction is a global issue that requires urgent attention as a result of an existing imbalance between the usage and replacement rates of sand and gravel. While the legal mining on one hand features participants like government of nations, individuals, and organizations who genuinely extract sand for the benefit of the society, illegal miners are those that extract sand and gravel without an authority backing their action to indulge in such. These illegal miners are also called sand mafias who on extreme cases kill and maim people who oppose their self interest.

Policy Implication

In as much as mining of natural resources are seen as contributing to economic growth, they also have serious negative impacts on the environment such as reduced rate of tourism due to continuous disappearance of beach sand by sand mafias (Kondolf, 1997); reduced fishing activities for commercial and subsistence purposes (Cooper, 2013; Desprez, Pearce & Le Bot, 2010); reduced farming activities affected by continuous loss of land emanating from marine erosion (John, 2009); reduced presence of insurance companies as a result of floods (Kondolf, 1997); droughts (John, 2009); and storm spurt through ineffective protection of beach fronts (Thornton, Sallenger, Conforto, Egley, McGee, & Pearsons, 2006).

In developing countries, the establishment of aggregate mining is without clear understanding of projects consequences where proper environmental impact assessments ought to have been ascertained ab initio (Maya, Santhosh, Padmala & Kumar, 2012; Saviour, 2012). Before now, aggregate extraction was done in land quarries and riverbeds; however, navigation towards marine and coastal aggregates mining indicates a decline in the available inland resources which also means that aggregate mining has affected the provision, protection and regulation of ecosystem services (UNEP, 2014), and With construction boom currently being experienced in Africa and Asia over the past two decades, it thus means that further heavy aggregate mining may still be witnessed globally (Rachel, 2019). Unavailability of extraction information in developing countries is a mishap that has limited the regulation of aggregate mining activities (Sreebha & Padmalal, 2011), with an exception of the European Union, inadequate regulatory efforts have resorted to illegal mining which triggers serious damage to the environment and ecosystem alike (UNEP, 2014).

Man's ever increasing demand for sand now poses sustainability challenges in this 21st century, as addressing these challenges require improved governance of global resources which political leaders ought to be strongly involved in this course (Rachel, 2019). In curbing irresponsible and illegal mining of aggregate extraction, UN environment programme (2019) in a report suggests customizing of existing standards and best practices aimed towards investing in sand production and consumption measurements, through monitoring, planning, and establishing dialogue between players and stakeholders in sand value chain based on transparency and accountability.

According to the UNEP Global Environmental alert Service (2014), excessive aggregate mining can be regulated if the following can be adopted and strictly adhered to;

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1. Reducing pressure on sand utilization can be made possible through efficient use of existing building and infrastructure. Also, recycling old buildings on the other hand can be a major source of obtaining sand substitute. Quarry dust can stand in as sand substitute when producing concrete structure (Khamput, 2006). It has been reported that desert sands can be utilized when mixed with essential materials (Cisse , Tamba, Diop & Sissoko, 2012; Zhang , Song, Yang & Liu, 2006)

2. The belief that sand is everywhere prompts people to conveniently extract it for whatsoever the purpose maybe thereby neglecting the repercussion of their actions. In a bid to tackle this environmental degradation, it therefore behooves the government of countries to increase tax on aggregate extraction in order to make sand alternatives attractive.

3. The roles of political leaders in managing the environmental impact of aggregate mining can no longer be ignored as these leaders are of the opinion that aggregate mining is yet to qualify as an issue that makes up their political discourse. Reason for this could be because sand disappearance is yet to reach the level of economic scarcity.

CONCLUSION

Reviewing and analyzing the concept of aggregate mining, its economic gains, ethical issues, policy implication has been the focus of this study. Deliberate attempts were made by the researcher to render clear and simple explanation regarding the universe, the earth and its existing natural resources. Among the existing natural resources, sand was specifically singled out because it holds the status of being the only most utilized natural resources only next to water yet having its consumption rate below its renewal rate when compared to other resources. Having based this research on existing data, statistics of how sand mining has been contributing to economic development reviewed as well as the environmental impact of excessive and illegal mining activities. In-spite of the outcry of environmentalists on the continuous degradation of the environment, it is however important to achieve and sustain economic stability both on the long and short run. In paying attention to the environmental impact of excessive aggregate mining, one should also bear in mind that man was not made for the environment but rather, the environment and all that exists therein were made for man as this is the view of liberalism on which social, economic, and political structures are built on. Regardless of the economic gains of sand mining, government of countries ought to establish strict policies regarding aggregate mining which is likely to environmental harm on both land and sea.

Finally, a balance rather than a quagmire ought to be established and maintained between excessive mining which promotes economic development on one hand, and the safety of the environment to prevent environmental degradation.

The researcher stands against illegal practices of sand mining and the harmful activities of sand mafias which have caused serious damage to the environment and have failed in all ethical standards. I believe the motive behind their activities is not on the greater good for the greater number of persons, and then their activities should be abhorred.

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