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EFFECTS OF CARBON EMISSION ON ENVIRONMENTAL QUALITY IN NIGERIA

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ABSTRACT

Nigeria'spursuit of economic growth leads to dependence on fossil fuel as a means of energy generation, in so doingfetching aboutcarbon emission which impacts environmental. As a means of finding solution to this problem, the study examines the effect of CO2 Emissionon environmental quality in country. Secondary data from 1992 to 2022 wasobtained from World Development Indicator (WDI, 2023) and U.S. energy information administration (EIA), 2024. Auto regressive distributive lag model (ARDL) was used as a method of estimation. The outcome reveals confirms strong evidence of cointegration between CO2 Emission on environmental quality. Log run and short run results show energy consumption of petroleum and other liquids relates positively and is significant in determining carbon emission. The study commends that Nigerian policy makers should design and implement sustainable energy policy and technologies in order to reduce carbon emission which is harmful to the environment and make more use of renewable energy such as sunlight, wind, rain, tides, waves, and geothermal heat which are healthier and cleaner choices of energy generation.

Keywords: CO_2 Emissions, Fossil Fuel, Economic Growth, Environment Quality, Climate Change

INTRODUCTION

The craving to heighten economic growth and development in the world leads to increase in industrialization and a speedyincrease in energy consumption which in turn lead to a continuous rise in Carbon emission (Alege, Adediran & Ogundipe, 2016). Worldwide energy demand raised up by 2.2% in 2017, from 1.2% in 2016 and over head its 10year average of 1.7%. Much of which is directly related to the pickup in economic growth

(BP Statistical Review of World Energy, 2018). For the previous two decades, thisincrease in Carbon emission lead to global warming, climatic change and degradation of environmental quality (Mohapatra & Giri, 2015). In 2018, the global annual growth rate of greenhouse gases emission increased to 2.0 percent owing toa 2.0 percent rise in Co_2 emission which amounted for about 72 percent of the total greenhouse gases emission (Olivier & Peters, 2019). In 2020, the emission reduced by 3.7% owing to COVID-19 pandemic, interrupting the more than ten-year continuous increasing trend.Not with standing, the trend picked up shortly after the peak of the pandemic, reaching in 2022 the level of 53.8 Gt Co_2eq, which is 2.3% higher than 2019 and 1.4% higher than 2021. In 2023, Co_2emission rose to 73.7% (EDGAR, 2024).

Africa in 2017 accounted for 1.33billion tons of Co_2 emission with an estimated 0.02% annual growth (GCP, 2018), this opened the continent to climate change which threatens sustainable growth and development (United Nations, 2006).

Nigeria is oneof the dominant contributors of Co_2 emission in the continent (Abu Sheha & Tsoko, 2019), resulting from fossil fuel combustion, electricity and heating generation, transportation, manufacturing, and construction (Ibrahim & Cudjoe, 2020). This lead to intensification in temperature, leading to drought and floods,increasing sea levels, adrop in water availability from 50% to 30%and a drop of about 20% in agricultural yields in the last few years (Alege, Adediran & Ogundipe, 2016). In line with this, the paper investigates the effect of carbon emission on environmental quality in Nigeria.

Though energy consumption is considered as an important driving force of economic growth and development, on the other hand it induces Co_2 emission which leads to global warming, climatic change and a reduction in environmental quality (Alege, Adediran & Ogundipe, 2016). In Nigeria, Carbon emission affects environmental quality through increased soil erosion, draughts, flooding, low agricultural product and crop yield owing to extreme weather; poor health as a result of hunger, malnutrition, mortality, increase in water-borne diseases such as typhoid fever, cholera, and increase in vector-borne diseases such as malaria ((Climate action and support trends, 2019). This justifies the need to investigate the effects of carbon emission on environmental quality in Nigeria.

LITERATURE REVIEW

Numeral literature has been carried out on carbon emission using single-nation as well as multi-nation data analysisusing a number of variables and also diverse methodologies to recognize the relationship amid these variables.

Ogundipe, Okwara, and Ogundipe (2020) examine the effect of fossil fuel consumption on environmental quality in Nigeria using secondary data from 1970 to 2017 acquired from World Development Indicator (WDI). The study employs Johansen co-integration analysis. Findings reveal that about 80% of carbon emissions in the country are direct consequence of fossil fuel combustion. Likewise, pollution was found to be a rising function of income and pollution upsurges as communities becomes more densely populated. Hence, the study vouches for an urgent design of sustainable energy framework and national sensitization on the multidimensional adverse consequences of the use of dirty fuels.

Waheed, Sarwar and Chen Wei (2019) using single country studies and multi-county studies reported that economic growth and energy consumption are important bases of carbon emission. In developing countries carbon emission is very much linked with economic growth. Opposing, in the advanced countries, carbon emission is not associated with economic development. To finish with, in both developingand advanced countries, high energy consumption was described as the focal culprit for carbon emission. The study recommends that governments and industries shouldswitch non-renewableenergy bases with renewable bases.

Liu, Lei, Zhang and Du (2019) for China, India and the G7 countries through the use of causality pointed out significant variations between emerging countries and advanced countries. A bi-directional link amid energy consumption, carbon emissions and economicgrowth is obtained in China and India, but numerous causal relationships are recognized in G7 countries, which consist of bidirectional, unidirectional and neutral connection.The study recommends policy authoritiesto frame new country-specific policies to acquire improved environmental quality while accomplishing sustainable economic growth.

Saudi, Sinaga and Jabarullah (2019) in Malaysia by way of annual data and auto regressive distributed lags (ARDLs) bound testing methodapproved that renewable energy consumption and technology innovation have significant and negative impact on carbon dioxide emission,however, non-renewable

energy consumption and economic growth have significant and positive effect on carbon dioxide emission.

Zaidi, Ahmed and Siok (2017) by means panel data involving of 17 technologically advancedset against 12 emerging countries showed a strong association between the energy consumption, economic growth and carbon emission. Findings clarifies that more than 84% of carbon emission is explained by economic growth and energy consumption, as suchmore energy consumption and lessereconomic growth may lead to environmental problems such as air and water pollution. Hence, the study advocates for prevention action to be in useso as to bring environmental degradation to its lowest possible minimum.

Alege, Adediran and Ogundipe (2016) for the case of Nigeria confirms that fossil fuel adds to carbon emissions while, clean energy source (electricity) lessen the concentration of carbon emissions in the atmosphere. By the same token, unidirectional causation runs from fossil fuel to carbon emissions and gross domestic product (per capita). On the other hand, non-fossil energy (electric power) roots more balanced change in GDP per capita and no causal link between electric power and carbon emissions is obtained. The study therefore suggests that in order to attain a sustainable environmental and economic development, fossil consumption should be substitutedwith clean energy sources.

Riti and Shu (2016) in Nigeria established co-integration amongstrenewable energy, fossil fuel consumption and environmental degradation. There is a significant relationship amid renewable energy and environmental quality. Hence forth the study supports for a shift in energy consumption policy from the traditional fossil fuel torenewable energy.

Mohapatra and Giri (2015) in India supports the presence of long run relationship among energy consumption, carbon emissions, economic growth and urbanization.Causality outcomespoint to the existence of unidirectional causality running from energy consumption and urbanization to carbon emissions and short run causality from economic growth to energy consumption.

The above literature did not consider the use of total energy consumption of petroleum and other liquids as a research variable, hence the study gap.

Theoretical Underpinning

The theoretical framework embraced in the study centered on the Environmental Kuznets Curve (EKC) hypothesis which states environmental

quality as a function of income. The hypothesis proposes an inverted-U relationship between environmental degradation and GDP per capita. The model states that economic development at first leads to deterioration in the environment, but after a certain level of economic growth, the society will start to improve its relationship with the environment and hence level of environmental quality will improve.

The study made use of the EKC hypothesis as a theoretical Frame work because it tried to explain the relationship between environmental quality and economic growths. Also the paper tried to explain the relationship between environmental quality and carbon emission using economic growth as one of the explanatory variables.

METHODOLOGY

To study the effect of carbon emission on environmental qualityin Nigeria, time series analysis was employed from 1992 to 2022. Data on carbon emission, gross domestic product, population densityand renewable energy consumption were sourced from world development indicators(WDI), 2023. While data on total energy consumption of petroleum and other liquids was sourced from U.S. energy information administration (EIA), 2024. The study adopts a modified model of Ogundipe, Okwara, and Ogundipe (2020). Thus, the study specifies the following model:

CE = f (ECP,GDP, PDY,REC)

Where *CE* = carbon emissionto be captured by Co_2 emission (kg per purchasing power parity $ of GDP), *ECP*= total energy consumption of petroleum and other liquids (quadrillion British thermal unit), *PDY*=population density (annual percentage), *GDP* = gross domestic product (Naira billions) and *REC* = renewable energy consumption (megawatt-hours).The econometric specification of equation (3.3) is indicated below:

$$CE_t = a_0 + \alpha_1 ECP_t + \alpha_2 GDP_t + \alpha_3 PDY_t + \alpha_4 REC_t + \varepsilon_t$$

Where subscript t stands for the period, a and α are the parameters in the model and ε is the stochastic error term.

The apriori expectation ($\alpha_1, \alpha_2, \alpha_3 > 0,\ \alpha_4 < 0$)

Estimation Technique

In order to achieve the objectives of the research, time series analysis which includes Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) unit root tests, and ARDL technique proposed by Pesaran, Shin and Smith (1999) were employed.Diagnostic tests in order tounderstand the nature of the variables, check for multicollinearity and heteroskedasticity among the

explanatory variables were also conducted, tests include; residual tests for serial correlation, heteroskedasticity and normality test.

Table 1: Unit root test (first difference level)

Variables	ADF	PP	ADF	PP
LCE	-0.278	-0.300	-5.228	-5.225
	(0.917)	(0.914)	(0.000)	(0.000)
LECP	-0.962	-0.697	-7.055	-7.055
	(0.755)	(0.833)	(0.000)	(0.000)
LGDP	-0.681	-0.305	-2.891	-2.866
	(0.837)	(0.913)	(0.055)	(0.061)
LPDY	-2.018	-0.492	-1.275	-3.019
	(0.278)	(0.880)	(0.054)	(0.044)
LREC	-1.515	-5.998	-6.01	
	(0.513)	(0.000)	(0.000)	

Source: Researcher's computation using E-views 10.

The analysis begins by examining the time series properties of the variables using Augmented Dickey Fuller (ADL) and Philips Perron (PP) unit root tests. Evidence from Table 3, using ADF test all the variables are statistically significant at 1stdifference. CE, ECP and REC are statistically significant at 1% level, while GDP and PDY are statistically significant at 10% level of significance. According to PP test, variable REC is statistically significant at level at 1% level of significance. Variables CE, ECP, are statistically significant at 1st difference at 1% of significance, while LGDP and LPDY are significant at 10% level of significance. Hence, the order of integration among the variables provides a justification for employing ARDL model in order to estimate their relationship.

Results of the Autoregressive Distributed Lag (ARDL) Model

In the ARDL, the appropriate model (number of lags) is selected automatically using (SC). Below, results of the diagnostics tests, bound test, long-run and short-run parameters of the model are presented.

Table 2: Bound Test Result

Statistics	Value		Critical Bound			
			1%	2.5%	5%	10%
F-statistic	19.14123*	I(o)Bound	3.29	2.88	2.65	2.2
		I(1)Bound	4.37	3.87	3.49	3.09

*indicates statistically significant at 1 percent level for all bounds.

Source: Researcher's computation using E-views 10 (2018).

Result of cointegration bound test relates a higher value of one-tailed F-statistic than any of the critical values of all bounds. Henceforth, result confirms a strong evidence of cointegration in the model at 1 percent.

Table 3: Long-run Result of the Variables

Variables	C-efficient	Std-error	T-statistics	Probabilty
LECP	0.784054	0.316161	2.479921	0.0276**
LGDP	-1.564809	0.053233	-29.39574	0.0000*
LPDY	2.707732	0.871697	3.106277	0.0083*
LREC	1.667314	1.407927	1.184233	0.2575

*, ** indicate significance at 1 and 5 percent levels.
Source: Researcher's computation using E-views 10 (2018).

The results shows energy consumption of petroleum and other liquids relates positively and is significantin determining carbon emission in the long run, a 1% increase in energy consumption of petroleum and otherliquids lead to a 0.7%increase in carbon emission indicating that carbon emission leads to deterioration of environmental quality in Nigeria.Gross domestic product relates negatively but significant in determining carbon emission. A 1% increase in gross domestic product leads to a 1.5% decrease in carbon emission. Population density relates positively and is significant in determining carbon emission. A 1% increase in population density leads to a 2.7% increase in carbon emission, this implies that as population increases, environmental quality decreases. Renewable energy consumption is not significant in determining carbon emission, this implies that it does not influence carbon emission meaning it does not affect environmental quality in the long run in Nigeria.

Table 4: Short-run Result of the Variables

Variables	C-efficient	Std-error	T-statistics	Probability
ECT(-1)	-0.703706	0.206491	-5.183652	0.0002
LECP	0.839233	0.287211	-2.922010	0.0119**
LGDP	-1.674935	0.309563	-5.410649	0.0001*
LPDY	2.898292	0.853853	3.394367	0.0048*
LREC	1.784653	1.722236	1.036242	0.3190

*, ** indicate significance at 1 and 5 percent levels.
Source: Researcher's computation using E-views 10 (2018).

From table 4, the speed of adjustment term is negativeand significant at one percent which implies that the coefficient is oscillatory and converging to the long-run equilibrium path.The coefficient corrects 0.7% of the error

annually. The short run result further indicates that in Nigeria, energy consumption of petroleum and other liquids is positive and statistically significant in determining carbon emission. 1% increase in energy consumption of petroleum and other liquids leads to 0.8% increase in carbon emission. Gross domestic product relates negatively and statistically significant in determining carbon emission. A 1% increase in gross domestic product leads to a 1.6% decrease in carbon emission. Population density is significant in determining carbon emission, 1% increase in population density leads to a 2.8% increase in carbon emission. This implies that population results to deterioration of environmental quality. Renewable energy consumption is statistically is not significant in determining carbon emission. This means that renewable energy consumption does not bring about deterioration of environmental quality.

Conclusion and Recommendations

The study concludes that energy consumption of petroleum and other liquids relates positively significantly with carbon emission both in the long and short run. The study therefore recommends that Nigerian policy makers should design and implement a sustainable energy policy and technologies so as to reduce carbon emission which is harmful to the environment. Policy makers, non-governmental organisations, civil society organizations and other relevant stakeholders should embark on sensitization and awareness programmes designed at making known to the populace the effects of carbon and other greenhouse gases on environment and human health, and effective mitigation approaches. The government and populace should adopt renewable energy such as sunlight, wind, rain, tides, waves, and geothermal heat which are healthier and cleaner choices of energy generation and to provide incentives to private investment in solar energy in the rural areas.

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