Impact of Energy Utilization on Pollution and Productivity in Nigeria

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Abstract

This study investigates the impact of Energy Utilization on Pollution and Productivity in Nigeria from 1990 - 2020. Thus, to measure the significance of the relationship existing among the study's primary variables (Energy, Production and Productivity), four data points were selected and analysed i.e., Fossil Fuel Consumption (FFC), Electricity Consumption (EC), Carbon Emission (CE) and Gross Domestic Product Growth Rate (GDPGR). These data were subjected to regression analysis at 5% level of significance using the ordinary least square method. Findings indicated that Fossil-Fuel Consumption has a positive and significant impact on economic growth and carbon emission, however, Electricity Consumption has a negative and significant impact on carbon emission but a positive and significant impact on economic growth. Based on these results, the study deduced that a long run positive relationship exists between Energy utilization and Productivity, also a positive but detrimental relationship exists between Energy and Pollution which may have a long-term adverse effect on the general welfare of the populace in terms of health implications and decline in productivity. Therefore, to enhance general welfare of the citizenry and boost productivity exponentially in the Nation, this study recommends that national energy mix be optimized by the government by minimizing use of energy sources that release carbon dioxide into the atmosphere and pursue development of environmentally friendly sources of energy.

Keywords: Energy utilization, Electricity consumption, Fossil fuel consumption, Pollution & Productivity

Introduction

Energy is an essential driver of economic growth everywhere in the world, in fact, the wealthy nations of the world consume a lot of energy for their economic sustenance. Energy demand fuels economic expansion. It is true that demand drives consumption. Hence, whatever ingested must have been desired. According to Adewuyi, Adeolu, Awodumi and Olabanji (2021), the increase in energy consumption has contributed to the acceleration of the world economy.

Alam (2016) concurs that there is a shift from neoclassical economics, which solely considers labour, capital, and technology as components of production, to one that now takes into account energy. Alam continued by saying that the labour required to transform raw materials into final goods throughout the manufacturing process is powered by energy. Increased power output, according to Sanchis (2017), will prevent the industrial production from coming to a halt. Production will eventually rise as a result of increased industrial production.

The creation of electricity, transportation, heating, and many more uses all depend on the energy from fossil fuels (coal, oil, and gas) i.e., non-renewable energy sources. Oil, gas, and coal are all abundantly available in Nigeria. According to the Draft National Energy Master Plan (2014) it is projected to contain proven reserves of around 35 billion barrels of oil, 2.7 billion tonnes of coal,

and 187 trillion barrels standard cubic feet of natural gas. The most obvious industrial activity in the nation is thus those that involve oil and gas. Around 95% of the nation's export revenue and 82% of all government revenue in 2016 came from oil and gas resources.

Industrial advancement requires massive energy particularly the burning of fossil fuels, however it also represents a central source of environmental degradation (Yu, Chow & Choi, 2018). The enormous oil breaches in the Gulf of Mexico, which released over 4.9 million barrels of crude oil, and the many oil spills in Nigeria have drawn attention to the potential catastrophes linked to the usage of fossil fuels, which can lead to environmental damage Adenikinju (2016). This phenomenon of oil spillage is very prominent in the Niger delta region of Nigeria where business activities such as farming fishing has been crippled because of the effects of Oil exploration also the youth labour force is more prone to picking up arms and oil bunkering than being gainfully employed. The inhabitants of the region have been subjected to untold hardship through oil pollution, environmental degradation, destruction of aquatic lives, and other negative activities that are inimical to the existence and survival of the people of the region as a result of oil exploration (Akpotor, 2019).

The ongoing use of these fossil fuels, however, has a negative influence on the ecosystem such as land degradation, marine contamination and air pollution caused by gas flaring and oil spills during vandalism, exploration, transportation and use. Government officials and experts in the area of environmental research have recently expressed concern about the alarming rate of environmental deterioration throughout the world resulting from large-scale deforestation and environmental pollution which is transforming the local climates as well as accelerating the rate of localized soil erosion, land degradation, loss of biodiversity and global warming.

There is clear evidence that greater global warming means increases in the risk of extreme weather events (Seneviratne *et al*, 2016) which will ultimately impact food security and hence high mortality rates in many regions (Betts et al, 2018). Thus, the shrinking of the ozone layer depletion has been a source of the global issue with human activities that releases dangerous greenhouse gases into the atmosphere (Freije *et al*, 2017). Notably scientist argue that climate change is happening mainly because of greenhouse gas emissions generated by human activities. By absorbing extra carbon from energy-related activities, biomass resources are able to replenish the atmosphere's oxygen supply, which is essential for human health. Nevertheless, this role is lost and the ecology suffers as a result of the burning of forests for fuel.

More than 70 million Nigerians who live in rural areas might reduce their carbon dioxide emissions by more than half if just two thirds of the estimated 9.6 billion hectares of forest and woods there are managed rather than removed or merely left to rot. According to experts, recent natural catastrophes worldwide are partially attributable to global warming which can be linked to fossil fuel use whose primary impact is increase in global temperatures which has exacerbates drought in certain regions and caused floods in others. The energy industry is one of the industries said to have contributed to this issue, particularly climate change. The production and consumption of fossil fuels, which increase carbon dioxide emissions, have been the energy sector's main contributor (a greenhouse gas [GHGs]).

Thus, from these issues discussed it is essential to examine the impact of energy consumption on environmental pollution and economic growth in Nigeria, identifying also the trajectory and linkages between environmental pollution and economic growth. So, in order to maintain

environmental sustainability, stakeholders must accept the task of solving the gaps that has been created by the constant usage of renewable energy particularly Fossil Fuel. Government must perform its regulatory functions successfully; investors should follow global best practices in energy exploitation; and engineering and scientific bodies must make sure that they use cutting-edge technology within the bounds of their respective professional ethics.

Literature Review and Theoretical Framework

Diverse Empirical studies have anatomized different forms through which the energy sector affects the terrain. Sabastari (2022) examined the unproductive relations between energy use, CO_2 emission and profitable growth in Sweden. Khan and Rehan (2021) delved into the nexus between energy consumption, profitable growth, and CO_2 emigration in Pakistan by using periodic time series data from 1965 to 2015. The estimated results of ARDL indicate that energy consumption and profitable growth increase CO_2 emissions in Pakistan both in the short run and long run. Grounded on the estimated results it is recommended that policy maker in Pakistan should borrow and promote similar renewable energy sources that will help meet the increased demand for energy by replacing old traditional energy sources like coal, gas and oil painting.

In an analogous study, Ewing *et al* (2017) delved into energy consumption carbon emission and profitable growth nexus in the United States for the period 1972- 2006. The methodology used was the Johansen Bivariate cointegration system, ARDL, and dynamic unproductive analysis. the result showed that CO2 granger beget both profitable growths in the short and long run. The result also indicated that a unidirectional reason exists between energy consumption to profitable growth both in the short and long run, while in the short run bidirectional relationship exists between energy consumption and profitable growth. The study concluded that carbon emigration influences profitable growth, likewise, Chontanawat *et al* (2016) studied the dynamic modelling of an unproductive relationship between energy consumption, CO2 emigration, and profitable growth in India with data covering 1971 to 2016. The methodology used is Granger's reason. The study verified the actuality of bidirectional Granger reason between energy consumption and CO2 emission in the long run but neither CO2 emigrations nor energy consumption and income in any direction in the long run. The study concluded that India could pursue energy conservation and emigration reduction with effectiveness enhancement programs without impeding profitable growth. In the same tone, Soytas and Sari (2017) examined the relationship between energy consumption profitable growth and carbon emission in Turkey. The disquisition employed the long-run Granger reason perspective in a multivariate frame. The study concluded that the lack of a long-run causal link between income and emissions implies that to reduce carbon emissions, Turkey doesn't have to abstain from profitable growth.

An analogous study by Adenikinju (2016) on the energy consumption carbon emigration and profitable growth in Nigeria recrimination for energy policy and climate protection in Nigeria. The study espoused a dynamic methodology in the form of Granger reason and dynamic retrogression model which came up with the findings that there's an unproductive relationship between oil painting products, carbon emigration from gas flaring and profitable growth in Nigeria. The study concluded that carbon emissions constitute a valid hindrance to sustainable profitable growth in Nigeria.

Alam (2016) studied the relationship between energy consumption and profitable growth. The study revealed that energy consumption causes carbon dioxide emissions in the short run, the study

concluded that in the long run, there appears to be a bidirectional reason running between energy consumption and carbon emigration.

In the African context, Zarnikau (2015) examined energy demand and economic growth: African Experience, which covered the period 1971 to 2011 with 19 African countries. The methodology used was the bound test approach. The study found evidence of a long-run relationship for only 8 of the 19 countries and causality for 12 of the countries. It shows that past values of economic growth have a predictive ability in determining the present value of energy consumption and past value of energy consumption has a predictive ability in determining the present value of economic growth. The study concluded that there was feedback income in African countries while there was a lack of causal relationship for others. Oviemuno (2006) in a study on climate change and sustainable development in Sub-Saharan Africa, using the panel cointegration method, shows that there is a strong positive relationship and sensitivity of climate change to growth. It was therefore concluded that countries should consider integrating climate variability issues in their national planning and development processes. In a similar study, Ayodele (2004) examines economic growth and environmental degradation in Nigeria. The study used a robust least square method of analysis. The result indicates an N-shape relationship between economic growth and environmental degradation. The study concluded that courageous policy measures of environmental preservation be adopted irrespective of the country's level of income.

Chiou-Wei *et al* (2008) investigated the impact of the quality of institutions (proxied by corruption) on the environment, employing the input-output approach and computable general equilibrium model. The study discovered that corruption tends to lower environmental quality. The study concluded that there existed a significant relationship between corruption and the environment. Still, on the energy and environmental issues, Glasure and Lee (2016) examine the impact of trade openness on the quality of the environment in Brazil, employing the input-output approach. The result reveals a positive link between foreign trade and CO2 emission, implying that trade openness contributes positively to environmental deterioration in the country. The study concluded that there existed a significant relationship between trade and the environment.

Theoretical Framework

The study is grounded on the environmental Kuznets curve. The environmental Kuznets curve is a hypothecated relationship between environmental quality and profitable development pointers of environmental decline tend to get worse as ultramodern profitable growth occurs until average income reaches a certain point over the course of development (Mills & Waite, 2009). Although the subject of continuing debate, some substantiation supports the claim that environmental health pointers, like water and air pollution, show an inverted U-shaped curve. It has been argued that this trend occurs at the position of numerous environmental adulterants, similar as sulfur dioxide, nitrogen oxide, lead, DDT, chlorofluorocarbons, sewage, and other chemicals preliminarily released directly into the air or water. The illustration in Figure 1 indicated that there exists a relationship between per capita income and environmental declination as shown by the reversed U shape.

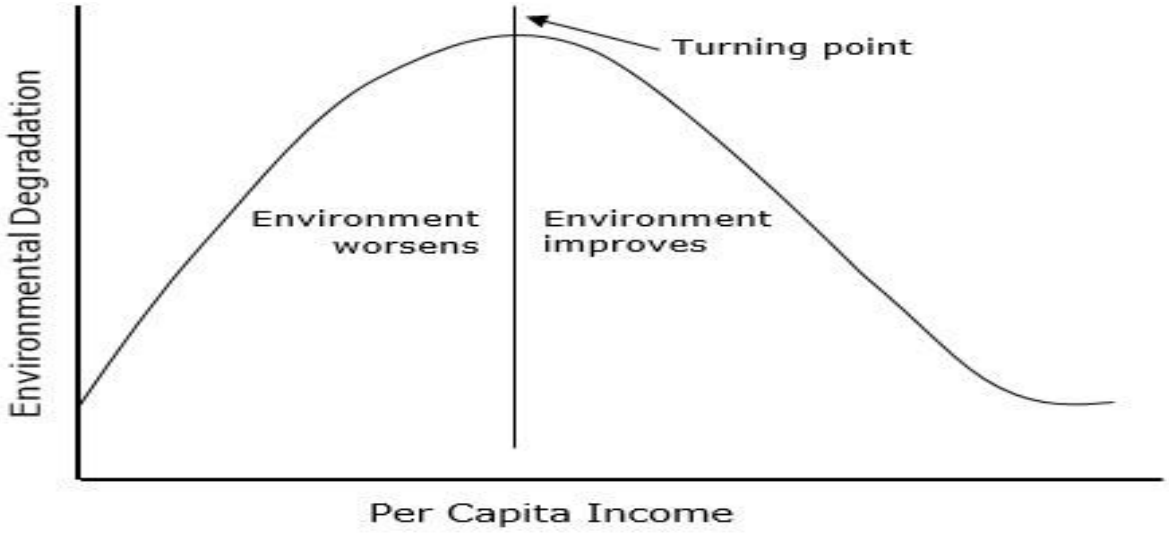

Figure 1**:** Kuznets reversed U shaped

For illustration, between 1970 and 2006, the United States affectation- acclimated GDP grew by 195, the number of buses and exchanges in the country further than doubled, and the total number of long hauls driven increased by 178. Still, during that same period, nonsupervisory changes meant that periodic emigrations of carbon monoxide fell from 197 million tons to 89 million, nitrogen oxides emigrations fell from 27 million tons to 19 million, sulphur dioxide emigrations fell from 31 million tons to 15 million, particulate emigrations fell by 80, and lead emigrations fell by further than 98.

Furthermore, there's little substantiation that the relationship holds for other adulterants, natural resource use, or for biodiversity conservation. For illustration, energy, land, and resource use (occasionally called the" ecological footmark") do not fall with rising income. While the rate of energy per real GDP has fallen, total energy use is still rising in utmost advanced countries. Another illustration is the emigration of numerous hothouse feasts, which is much more advanced in industrialized countries. In addition, the status of numerous crucial" ecosystem services" handed by ecosystems, like brackish provision and regulation Lee (2006), soil fertility, and fisheries, have continued to decline in advanced countries.

In general, Kuznets angles have been set up for some environmental health enterprises (like air pollution) but not for others (like tips and biodiversity). lawyers of the EKC argue that this does not inescapably abate the thesis – the scale of the Kuznets angles may differ for different environmental impacts and different regions. However, it may yet be the case that a given area will need further wealth to see a decline in environmental adulterants If the hunt for scalar and indigenous goods can regain conception. In discrepancy, thermodynamically enlightened economics suggests that labours of demoralized matter and energy are a necessary consequence of any use of matter and energy (so holds the alternate law); some of those degraded labours will be noxious wastes, and whether and how their product is excluded depends more on nonsupervisory schemes and technologies at use than on income or product situations. In one view, also, the EKC suggests that" the result of pollution is further profitable growth;" in the other, pollution is seen as a tragic affair that should be reduced when the benefits brought by its product are exceeded by the costs it imposes in externalities like health reductions and loss of ecosystem services.

Methodology

Research Design

This study used quantitative method to assess the relationship between Energy consumption, Pollution and Productivity from 1990 to 2020. Specifically, the study used Ordinary Least Squares (OLS) model to analyse the relationship among Energy consumption, Pollution and Productivity. The study area was limited to Nigeria comprising the 36 states and Federal Capital Territory.

Specification

From the theoretical framework which is the Kuznets environmental curve, this section will focus mainly on formulating a model to estimate the relationship among Energy consumption, Pollution and Productivity in Nigeria. The researcher used Ordinary Least Squares (OLS) model to analyse the relationship among the variables and GDP. The researcher assumed that Carbon Emission, Fossil Fuel Consumption and Electricity Consumption are the only variable that influences Nigeria's Gross Domestic Product Growth Rate (GDPGR)

Accordingly, a simple linear regression model using OLS is formulated as in the model equation below.

The model equation is: $Y = \beta_0 + \beta_1 (R1 + R2 + R3) + \varepsilon$.
Where:
Y = Gross Domestic Product Growth Rate (dependent variable),
R_1 = Carbon Emission (independent variable),
R_2 = Fossil-Fuel Consumption (independent variable),
R_3 = Electricity Consumption (independent variable),
β_0 = intercept,
β_1 = coefficient representing the impact of energy utilization, pollution and productivity on GDP
ε = error term accounting for unobserved factors

Data Source

Primary and secondary sources are the two principal sources from which data may be gathered for research or study purposes. Thus, in our study, secondary approach was employed to obtain data. This method is thought to be the approach that best suits the research information and takes up the least amount of time. The National Bureau of Statistics (NBS), Nigeria Extractive Industry Transparency Initiative (NEITI), World Bank Statistics and Macro Trend Statistics are the sources for this research secondary data.

Methods of Data Analysis

In this study, quantitative method was used to analyse the selected data on the IBM SPSS statistics. Also, in order to get a clearer picture of the movement and behaviour of the selected time series data, a trend analysis was conducted using the 2016 Excel Office suite Package.

Data Analysis and Interpretation

Table 1. Data Table

YEAR	Carbon Emission in Kilo Tons	Electricity Consumption (Twh)	Fossil Fuel Consumption (bbls)	Gross Domestic Product Growth Rate (%)
1990	72,768.80	204.00	646.79	0.12
1991	81,926.10	225.00	735.24	0.00
1992	91,806.40	230.00	701.10	0.05
1993	86,237.30	234.00	690.47	-0.02
1994	78,325.80	218.00	659.14	-0.02
1995	86,164.50	242.00	776.67	0.00
1996	100,227.20	248.00	798.54	0.04
1997	98,646.90	249.00	800.49	0.03
1998	88,699.80	238.00	866.65	0.03
1999	87,017.00	239.00	866.24	0.01
2000	97,215.10	224.00	894.51	0.05
2001	101,945.30	254.00	790.96	0.06
2002	92,237.60	265.00	765.25	0.15
2003	100,994.90	280.00	801.97	0.07
2004	98,724.00	290.00	858.20	0.09
2005	98,719.00	317.00	917.73	0.06
2006	88,767.70	283.00	394.90	0.06
2007	81,122.60	259.00	348.82	0.07
2008	86,932.00	312.00	274.23	0.07
2009	76,947.40	196.00	321.86	0.08
2010	90,055.20	244.00	316.64	0.08
2011	94,996.50	347.00	300.72	0.05
2012	95,335.30	346.00	188.31	0.04
2013	108,116.80	455.00	177.52	0.07
2014	114,815.50	486.00	218.86	0.06
2015	107,746.40	459.00	218.86	0.03
2016	110,817.50	470.00	218.86	-0.02
2017	108,481.20	456.00	220.51	0.01
2018	113,633.10	488.00	172.98	0.02
2019	119,544.10	505.00	99.10	0.02
2020	111,978.10	509.00	180.38	-0.02

Trend Analysis

The trend analyses revealed graphically that the variables fluctuated occasionally over time as a result of political and economic factors over the research period.

Carbon Emission and Electricity

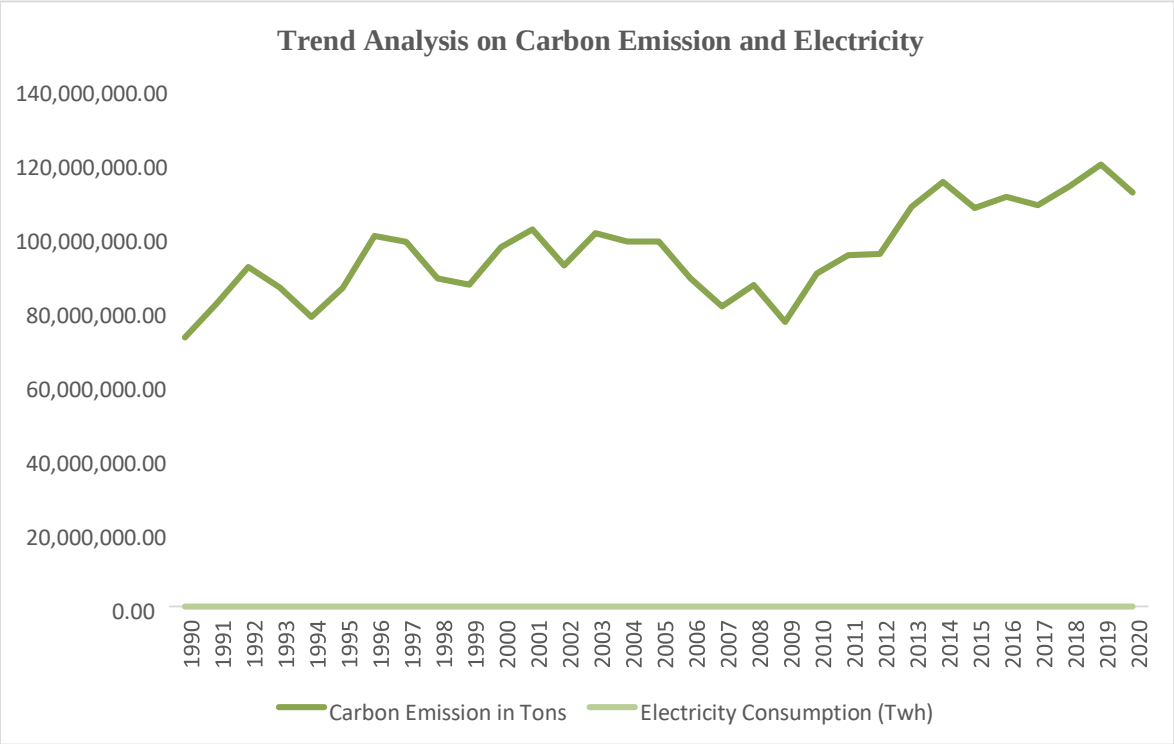

Figure 2. **Trend analysis of Carbon Emission and Electricity**

Figure 2 above indicates an upward trend in Carbon Emission with no significant change in the movement of electricity indicating that, though carbon Emission is influence by electricity but at a very minimal rate.

Carbon Emission and Fossil Fuel Consumption

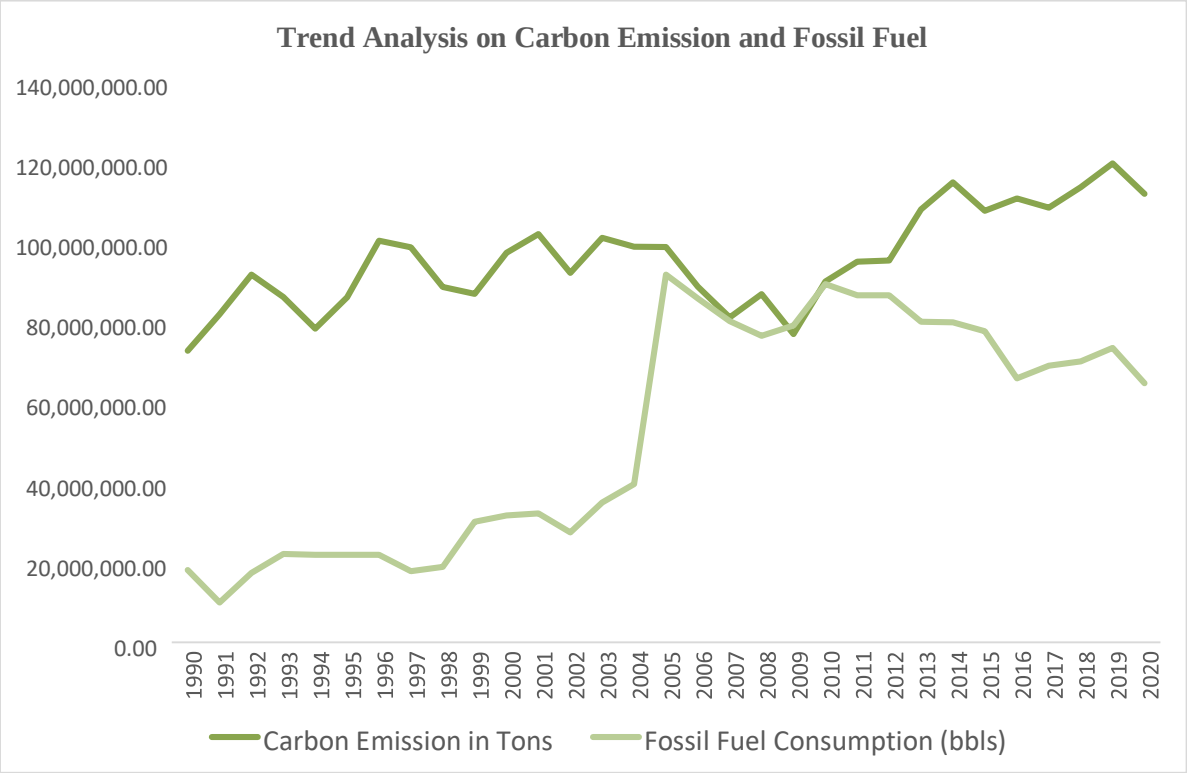

Figure 3. **Trend analysis of Carbon Emission and Fossil Fuel**

Figure 3 above indicates an almost proportional upward trend in Carbon Emission and Fossil Fuel consumption indicating that the more fuel is consumed the more carbon that is dispersed. Thus, it can be concluded that Fossil Fuel is the major contributing factor to the rise in carbon Emission in Nigeria.

Carbon Emission and GDPGR

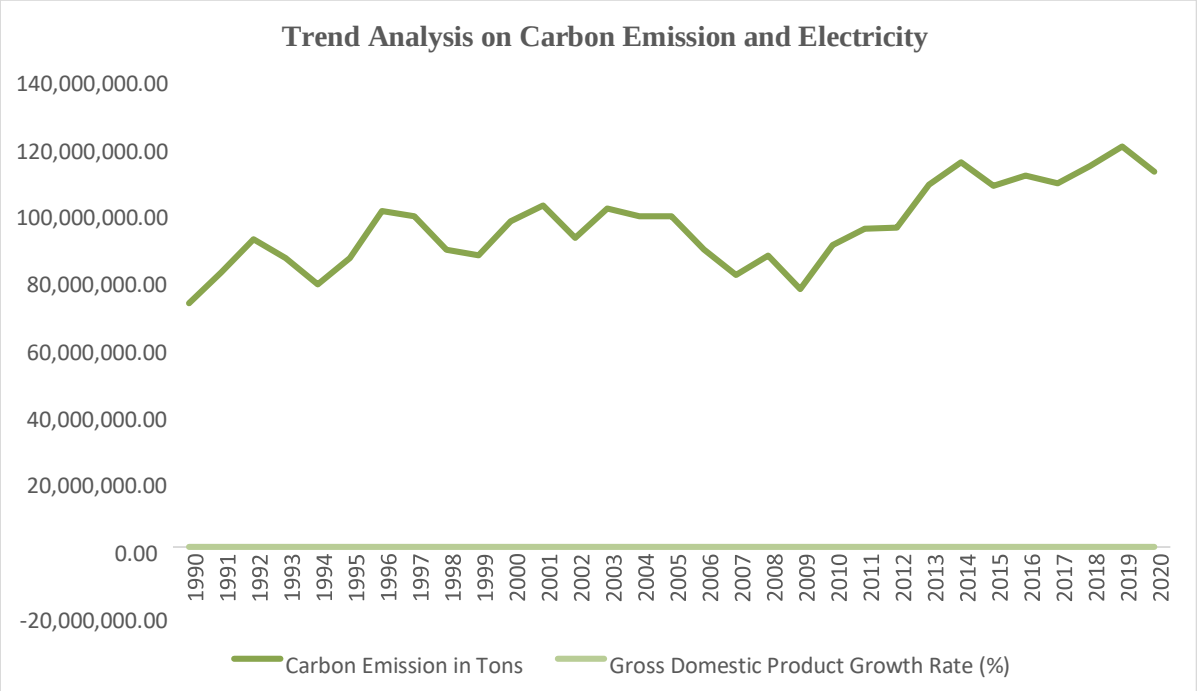

Figure 4. **Trend analysis of Carbon Emission and Fossil Fuel**

Figure 4 above indicates an upward trend in Carbon Emission and an almost linear movement by GDPGR. This indicates a negative relationship between the variables, thus, rise in carbon Emission brings about a decrease in productivity in the long run.

Regression analysis and interpretations

Table 2. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.890[a]	.793	.770	5810479.61378

a. Predictors: (Carbon Emission - Constant), GDP, Fossil Fuel Consumption, Electricity Consumption

The value of R2 which is 0.793 indicates that the independent variable (GDP growth rate, fossil fuel, electricity) explains only 79.3% of the systematic variation of the dependent variable (GDP) leaving 20.7% unaccounted for. This figure further reduces to 77.0% when the R-squared statistics is further adjusted. This means that GDP rate, Fossil fuel, Electricity and other factors/determinants are responsible for the increased carbon emission rate in Nigeria.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3487358124754551.000	3	1162452708251517.000	34.431	.000[b]
	Residual	911565180238998.400	27	33761673342185.125		
	Total	4398923304993549.000	30			

a. Dependent Variable: Carbon Emission

b. Predictors: (Constant), GDP, Fossil Fuel Consumption, Electricity Consumption

The F statistic of 34.431 is not significant at 0.000. This means that there is no statistically significant relationship between GDP rate, Fossil fuel, Electricity and carbon emission.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	60420352.910	4142533.945		14.585	.000
	Electricity Consumption	118216.224	12713.498	1.021	9.298	.000
	Fossil Fuel Consumption	-.099	.046	-.235	-2.168	.039
	GDP	1196018.949	683522.056	.157	1.750	.092

a. Dependent Variable: Carbon Emission

$H_0$1: There is no significant relationship between Fossil fuel, Electricity, GDP rate and carbon emission in Nigeria.

The p- values of 0.000 shows that Fossil fuel, Electricity, GDP rate is significant at 0.05 level of statistical significance. The analysis therefore rejects the null hypothesis which states that there is no significant relationship between fossil fuel consumption, electricity consumption, gross domestic product growth rate and carbon emission in Nigeria at t-value of 14.585 and P-values of 0.000. The implication of this is that fossil fuel consumption, electricity consumption and gross domestic product growth rate does statistically predict carbon emission rate in Nigeria.

Conclusion

From the study carried out, it would be a fallacy to conclude that there is no relationship among energy consumption, pollution and productivity i.e., economic growth. The evidence from analyses from this study revealed that, energy consumption has statistically significant effect on pollution as shown by carbon emission in Nigeria. This is evident given the contributions of energy indicators in the economy. And most importantly, it was deduced that, there exist a significant relationship between energy usage and economic growth. The implies that a high carbon source content of Nigeria's energy mix can lead to environmental degradation.

Recommendations

Based on the findings of the study, the following recommendations are made;

i. The national energy mix should be optimized by the government. This calls for a decrease in energy sources that release carbon dioxide and an increase in the production of energy from environmentally friendly sources.
ii. Energy sources such as Fossil fuels consumption should be reduced and substituted in the long run to other less harmful sources such as solar and Hydropower.
iii. Clean energy sources should be made available in the economy since energy utilization creates economic growth. As energy consumption is a major driver of economic growth, the Nigerian government must prioritize the provision, management and development of clean and sustainable energy sources.

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