IRJEMS International Research Journal of Economics and Management Studies
Published by Eternal Scientific Publications
ISSN: 2583 – 5238 / Volume 2 Issue 3 September 2023 / Pg. No: 653-662
Paper Id: IRJEMS-V2I3P181, Doi: 10.56472/25835238/IRJEMS-V2I3P181

Original Article

Impact of Energy Consumption on Environmental Pollution and Economic Growth in Nigeria

[1]Ihim Uchechukwu James, [2]Dr. Sabiu Sani B.
[1,2]Department of Economics, University of Abuja.

Received Date: 22 September 2023 Revised Date: 28 September 2023 Accepted Date: 30 September 2023 Published Date: 04 October 2023

Abstract: *Energy consumption drives economic growth and development in every country, affecting industrial, transportation, residential, and commercial activity. The contradictory link between energy use, environmental damage, and economic development presents difficulties and possibilities for the nation. Countries' energy sources and consumption habits affect their environmental sustainability and economic growth. Nigeria, Africa's most populous country and fastest-growing economy, is facing the repercussions of its energy consumption decisions. This article discusses the intricate relationship between Nigeria's energy use, pollution, and economic growth, highlighting its challenges and future opportunities. Using the ordinary least squares approach, regression analysis was performed on these data at the 5% level of significance. Findings showed that whereas the use of fossil fuels has a negative and significant influence on carbon emissions, the use of electricity has a positive and large impact on both economic growth and carbon emissions. These findings support the hypothesis that there is a statistically significant association between Nigeria's consumption of fossil fuels, power, GDP growth rate, and carbon emission rate. Nigeria must therefore investigate and invest in alternate and cleaner energy sources to lessen its reliance on fossil fuels in order to boost economic growth. Also, promoting energy-efficient technologies and practices in electricity consumption can help lower carbon emissions. Policymakers should focus on promoting green and sustainable economic growth to mitigate carbon emissions, strengthening and enforcing environmental regulations related to carbon emissions can help control and reduce the impact of economic activities on the environment.*

Keywords: *Carbon Emission, Fossil-Fuel Consumption, Electricity Consumption, Economic Growth.*

I. INTRODUCTION

Energy use is a key factor in economic development and growth in any country, having a significant impact on a range of economic activities, from manufacturing and transportation to residential and commercial pursuits (Chinedu, Daniel, & Ezekwe, 2019). The paradoxical link between energy use, environmental harm, and economic expansion, however, presents both substantial challenges and opportunities for the nation. The energy sources and consumption patterns in a country can significantly impact both its environmental sustainability and economic prosperity. (Ayinde, Celik, & Gylych, 2019). Nigeria, as one of the most populous nations in Africa and a rapidly growing economy, finds itself at a critical juncture where the consequences of its energy consumption choices are becoming increasingly evident. This study illuminates Nigeria's prospects and challenges as it works to achieve a sustainable and prosperous future by examining the complex relationship between energy consumption, environmental harm, and economic growth.

Energy use must be recognised as a crucial component of Nigeria's economic development. The nation's demand for energy has soared in recent decades, driven by population growth, urbanization, and industrialization. As Nigeria continues to develop and diversify its economy, the need for reliable and affordable energy becomes even more pronounced (Okoye, L. 2021). The energy sector, therefore, holds the key to unlocking the full potential of Nigeria's economic growth, which is essential for poverty reduction, job creation, and improved living standards for its citizens (Dantama, Abdullahi, & Inuwa, 2012). However, this robust demand for energy has a flip side, as it contributes significantly to environmental pollution. Nigeria's heavy reliance on fossil fuels, particularly oil and natural gas, has resulted in elevated levels of air and water pollution, deforestation, and other environmental degradation. The negative externalities of energy consumption are not only detrimental to the environment but also pose health risks to the population (Somoye, Ozdeser, & Seraj, 2022). Thus, there is an urgent need for Nigeria to address the environmental implications of its energy consumption patterns.

Nigeria, one of Africa's major economies, has had significant economic expansion over the years, which has been mostly supported by its energy-intensive industries including mining, manufacturing, and oil and gas production. This economic expansion has led to a surge in energy demand, primarily met by fossil fuels (Ogundipe, Akinyemi, & Ogundipe, 2016). While energy is essential for development, its heavy reliance on fossil fuels has raised serious environmental concerns. The burning of fossil fuels for energy generation releases greenhouse gases, contributing to global climate change, and results

in various forms of local and regional pollution. Environmental pollution in Nigeria is not limited to greenhouse gas emissions but extends to air and water pollution, deforestation, and degradation of ecosystems (Saidi & Hammami, 2015). These environmental challenges pose significant health risks and economic burdens, affecting the quality of life for Nigerian citizens and hindering sustainable development efforts. Moreover, the degradation of Nigeria's natural resources and ecosystems can exacerbate issues such as food security and water scarcity, further straining economic growth (Chindo, Abdulrahim, Waziri, Huong, & Ahmad, 2015).

Though complex, the link between energy use, environmental harm, and economic expansion poses a serious policy conundrum for Nigerian decision-makers. On the one hand, energy consumption is needed for running businesses and keeping the economy growing, which is necessary for creating jobs and reducing poverty (Ali, Law, & Zannah, 2016). On the other hand, the unchecked use of energy, especially from fossil fuels, can lead to severe environmental consequences that undermine long-term economic sustainability. The challenge Nigeria faces lies in reconciling the imperative for continued economic growth with the pressing need to mitigate environmental pollution stemming from energy consumption (Abalaba & Dada, 2013). As the nation's economy grows, driven in large part by energy-intensive sectors, it simultaneously contributes to environmental degradation through its heavy reliance on fossil fuels. This dichotomy creates a formidable obstacle to sustainable development and necessitates the urgency of this study (Maji, 2015). This study tries to offer practical routes and policy answers that can promote economic success while reducing the environmental cost by thoroughly investigating the complex relationship between energy consumption, environmental degradation, and economic growth in Nigeria (Ayinde, Celik, & Gylych, 2019). Addressing this challenge is imperative for Nigeria's long-term well-being, public health, and environmental sustainability, aligning with global efforts to combat climate change and promote sustainable development (Awodumi & Adewuyi, 2020).

II. LITERATURE REVIEW

A) Energy Consumption

Energy consumption refers to the utilization of energy resources, typically in the form of electricity, fossil fuels, or renewable sources, to power various human activities and systems. It is a crucial aspect of modern society, as energy is fundamental for almost every aspect of our daily lives, from heating and cooling our homes to fueling transportation and powering industries (Nathaniel, 2020). Energy consumption is often categorized into different sectors, including residential, commercial, industrial, and transportation, each with its own unique energy demands and patterns. According to Amasyali and El-Gohary (2018), a country or region's level of energy consumption is a key sign of how economically developed it is and how high its standard of living is. But excessive energy use can have negative effects on the environment, like rising greenhouse gas emissions and climate change. As a result, there is a growing focus on boosting energy efficiency and switching to cleaner, more sustainable energy sources in order to lessen the environmental impact of energy use and satisfy the future's rising global energy demands. This shift towards sustainable energy practices is essential to ensure a more resilient and environmentally responsible energy future (Ahmad & Zhang, 2020).

Energy consumption refers to the total amount of energy used by a society, organization, or individual over a specified period, typically measured in units like joules or kilowatt-hours. It is a critical indicator of a nation's or a household's economic and environmental sustainability. Energy consumption is typically categorized into different sectors, including residential, commercial, industrial, and transportation (García-Martín, Rodrigues, Riley, & Grahn, 2019). There are many other types of energy that can be used for consumption, including nuclear energy as well as fossil fuels like coal, oil, and natural gas. A large amount of the world's energy is consumed by the residential sector, primarily for lighting, heating, and cooling homes and powering appliances (Wei, Zhang, Shi, Xia, Pan, Wu, & Zhao, 2018). In recent years, efforts have been made to improve residential energy efficiency through measures like better insulation, energy-efficient appliances, and the adoption of renewable energy sources, reducing the environmental impact of energy consumption.

The commercial and industrial sectors are major consumers of energy, with industries relying heavily on electricity and fossil fuels for manufacturing processes. Energy-intensive industries like steel and chemical manufacturing have been working to reduce their energy consumption and emissions through technological advancements and cleaner energy sources (Ladha-Sabur, Bakalis, Fryer, & Lopez-Quiroga, 2019). Transportation is another crucial sector responsible for a substantial portion of energy consumption, primarily reliant on petroleum-based fuels. The shift towards electric vehicles (EVs) and alternative transportation modes, coupled with advancements in fuel efficiency, has the potential to significantly reduce energy consumption in this sector (Seyedzadeh, Rahimian, Glesk, & Roper, 2018). Efforts to manage and reduce energy consumption are critical for mitigating climate change, conserving finite energy resources, and achieving sustainability goals. Governments, businesses, and individuals are increasingly adopting energy-efficient technologies, renewable energy sources, and energy conservation practices to minimize their energy consumption and its associated environmental impacts (Waheed, Sarwar, & Wei, 2019). As we move into the future, the challenge remains to strike a balance between meeting the growing global energy

demand and addressing the environmental consequences of excessive energy consumption (Sedlmeir, Buhl, Fridgen, & Keller, 2020).

B) Environmental Pollution

When dangerous chemicals are introduced into the environment, it is referred to as environmental pollution. This has a negative impact on ecosystems and living things. This pervasive problem includes different types of pollution, such as noise, air, water, and soil contamination. According to Fayiga, Ipinmoroti, and Chirenje (2018), each type of pollution has specific effects on the environment and human health. Particulate matter, carbon monoxide, sulphur dioxide, nitrogen oxides, and volatile organic compounds are the main pollutants that are released into the air and contribute to air pollution. These contaminants frequently come from vehicles, burning fossil fuels, and industrial processes. The health of people and the environment can be negatively impacted by air pollution, which can include respiratory conditions, smog, acid rain, and harm to vegetation (Ajibade, Adelodun, Lasisi, Fadare, Ajibade, Nwogwu, & Wang, 2021). Water pollution occurs when contaminants enter water bodies like rivers, lakes, and oceans. Sources of water pollution include industrial discharges, agricultural runoff, sewage disposal, and oil spills. Pollutants like heavy metals, pesticides, pathogens, and plastics can contaminate aquatic ecosystems, harm aquatic life, and compromise drinking water quality, thereby endangering human health and the environment (Liu, Lu, Zhang, Liu, & Jiang, 2022).

Soil pollution involves the contamination of the Earth's topsoil with hazardous substances like heavy metals, pesticides, and industrial waste. This can lead to soil degradation, reduced agricultural productivity, and the accumulation of toxins in food chains (Xu, Yang, Huang, & Failler, 2022). Soil pollution can also affect groundwater quality, as pollutants may leach into underground aquifers, further threatening human health and ecosystem stability. Noise pollution results from excessive and unwanted sound levels, often generated by transportation, industrial activities, and urbanization (Liu & Lin, 2019). Prolonged exposure to high noise levels can cause stress, sleep disturbances, and hearing impairment in humans, while disrupting wildlife behavior, communication, and habitats. Environmental pollution poses a significant global challenge, necessitating concerted efforts to mitigate its detrimental effects on both ecosystems and human health through sustainable practices, policy interventions, and public awareness campaigns (Tsai, Wu, Huang, & Chen, 2021).

C) Economic Growth

A key idea in economics is economic growth, which is the gradual increase in a country's capacity for production. The Gross Domestic Product (GDP), which represents the entire dollar worth of products and services generated inside a nation's borders during a certain time period, is sometimes used as a proxy for this. According to Li, Jin, and Shi (2018), economic growth is a significant measure of a country's overall economic health and is essential for raising the standard of living and enhancing the welfare of its population. The development and invention of technology is one of the main factors influencing economic progress. Productivity rises as societies create new technology or discover more effective methods of manufacturing goods and services. This, in turn, can result in higher GDP and a rise in living standards. Investments in research and development, education, and infrastructure play a crucial role in fostering technological progress and driving economic growth (Kuznets, 2019).

Economic growth also depends on factors like capital accumulation and labor force expansion. When individuals and businesses invest in physical capital, such as machinery and equipment, it enhances productivity, contributing to economic growth (Bosma, Content, Sanders, & Stam, 2018). Additionally, a growing and skilled labor force can boost economic output as it enables more work to be done and can lead to increased innovation and specialization. Sustainable economic growth is a goal for many countries, as it allows for a higher quality of life, increased job opportunities, and improved public services (McClelland, 2019). However, it is essential to manage growth to ensure it is inclusive and environmentally sustainable, avoiding negative consequences such as income inequality and ecological degradation. Policymakers must strike a balance between promoting economic growth and addressing its social and environmental impacts to create a prosperous and equitable future for all (Frick & Rodríguez-Pose, 2018; Gründler & Potrafke, 2019).

D) Theoretical Framework

The underpinning theories for this study are the Environmental Kuznets Curve (EKC) and Resource Curse theories. The two theories offer valuable frameworks for understanding the complex dynamics at play in Nigeria's energy consumption, environmental pollution, and economic growth (Dogan & Inglesi-Lotz, 2020). According to the Environmental Kuznets Curve theory, there is a connection between environmental deterioration and economic growth. It shows that as a result of rising industrialisation and energy use during the early phases of economic growth, environmental degradation tends to worsen. Additionally, the Environmental Kuznets Curve (EKC) theory postulates a connection between income levels, environmental deterioration, and economic growth. It asserts that due to rising industrialisation and energy use in the early stages of economic growth, environmental degradation tends to get worse (Gill, Viswanathan, & Hassan, 2018).

The Resource Curse theory, on the other hand, focuses on the paradoxical challenges faced by countries rich in natural resources, such as oil and minerals. It suggests that an overreliance on resource exports can lead to economic volatility, governance issues, and environmental degradation (Manzano & Gutiérrez, 2019). In Nigeria's case, where oil has been a dominant resource, this theory is highly pertinent. It can help researchers analyze how Nigeria has managed its oil wealth and whether it has translated into sustainable economic growth. By examining the impact of oil wealth on governance structures, diversification efforts, and environmental policies, this theory can provide insights into how Nigeria can better harness its resources to achieve economic growth without sacrificing environmental sustainability (Smith & Waldner, 2021). For the study of energy consumption, environmental pollution, and economic growth in Nigeria, both the Resource Curse and the EKC theories provide insightful information. The Resource Curse hypothesis cautions against the dangers of resource dependence, whereas the EKC theory offers hope that economic expansion would eventually result in less environmental devastation (Onifade, 2022). Combining these theories in the study allows for a comprehensive analysis of Nigeria's unique circumstances and offers guidance on policy measures that can help the nation achieve sustainable economic growth while mitigating environmental pollution and resource-related challenges (Vahabi, 2018).

III. METHODOLOGY

The relationship between energy use, pollution, and economic growth from 1990 to 2020 was examined using a quantitative methodology. In order to specifically assess the relationship between energy consumption, pollution, and economic growth, the study used the Ordinary Least Squares (OLS) model. The study area was limited to Nigeria comprising the 36 states and Federal Capital Territory. The sample size selected for this study comprise data for Energy Consumption (Fossil Fuel, Electricity), Pollution (Carbon Emission) and GDPR gathered from 1990 t0 2020.

This research employed a secondary data approach to gather information, which was considered the most suitable and time-efficient method for obtaining the required data. The sources for this secondary data included the National Bureau of Statistics (NBS), Nigeria Extractive Industry Transparency Initiative (NEITI), World Bank Statistics, and Macro Trend Statistics.

From the theoretical framework which is the Kuznets environmental curve and Resource Curse theories, this section focused mainly on formulating a model to estimate the relationship among Energy consumption, pollution and economic growth 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: $Y = \beta_0 + \beta_1 (R1 + R2 + R3) + \mathcal{E}$.

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 economic growth on GDP
ε = error term accounting for unobserved factors

IV. DATA ANALYSIS AND INTERPRETATION

This study's main goal is to look into the relationships between pollution, energy use, and economic growth. Consequently, this section encompasses the outcomes derived from the data analysis, their interpretation, and their implications for Nigerian society. Additionally, it provides specific information regarding the data selected for this research, as illustrated in Table 1 below.

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

A) Data Analysis

This study examined the complex relationships that exist between energy use, pollution, and economic expansion. Consequently, this section of the study encapsulates the presentation and analysis and results of the obtained data, shedding light on its implications for Nigerian society. The section also presented the results derived from the data analysis, an in-depth interpretation of these results, exploring the nuances and connections between energy consumption, pollution, and economic growth. Finally, it discussed the practical implications of these findings for the Nigerian society, underlining the potential consequences and opportunities that may arise as a result of the relationships identified in the study.

a. Trend Analysis

The trend analyses, when depicted graphically, clearly demonstrated that the variables exhibited periodic fluctuations throughout the research period. These fluctuations were primarily attributed to the dynamic influence of various political and economic factors. The graphical representations of the data allowed the researcher to visually observe how these variables evolved over time. These fluctuations often mirrored the ebb and flow of political events, such as changes in government policies or leadership, as well as economic factors like shifts in market conditions, trade dynamics, and resource availability. In essence, the graphical trend analyses provided a dynamic perspective on how the interplay between these variables unfolded over time, highlighting the role of external factors, particularly those related to politics and economics, in shaping the observed patterns and trends. This insight deepens our understanding of the complex relationships between these variables and underscores the need to consider these external influences when interpreting the study's findings.

b. Carbon Emission and Electricity

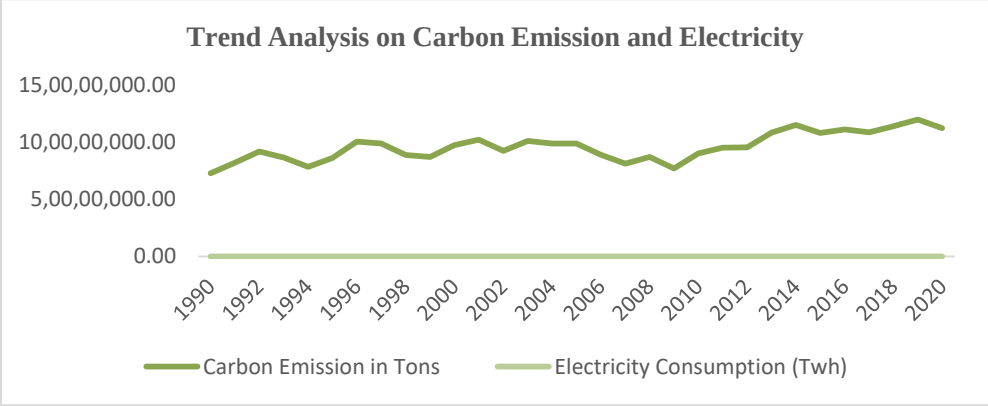

Figure 1: Trend analysis of Carbon Emission and Electricity

As depicted in Figure 1 above, there is a noticeable upward trend in Carbon Emission, while the movement of electricity shows relatively little significant change. This suggests that there is indeed a relationship between Carbon Emission and electricity consumption, albeit with a minimal rate of influence from electricity on Carbon Emission levels. In other words, the data presented in Figure 4.1 implies that as electricity consumption remains relatively stable or experiences minor fluctuations, the Carbon Emission levels tend to steadily increase over time. However, the influence of electricity consumption on Carbon Emission is not pronounced or substantial. Other factors or variables may be playing a more dominant role in driving the observed increase in Carbon Emission. This finding underscores the complexity of the relationship between energy consumption (electricity) and environmental impact (Carbon Emission) and suggests that other factors, such as industrial processes, energy sources, or policy interventions, may be exerting a more significant influence on the observed rise in Carbon Emission levels.

c. Carbon Emission and Fossil Fuel Consumption

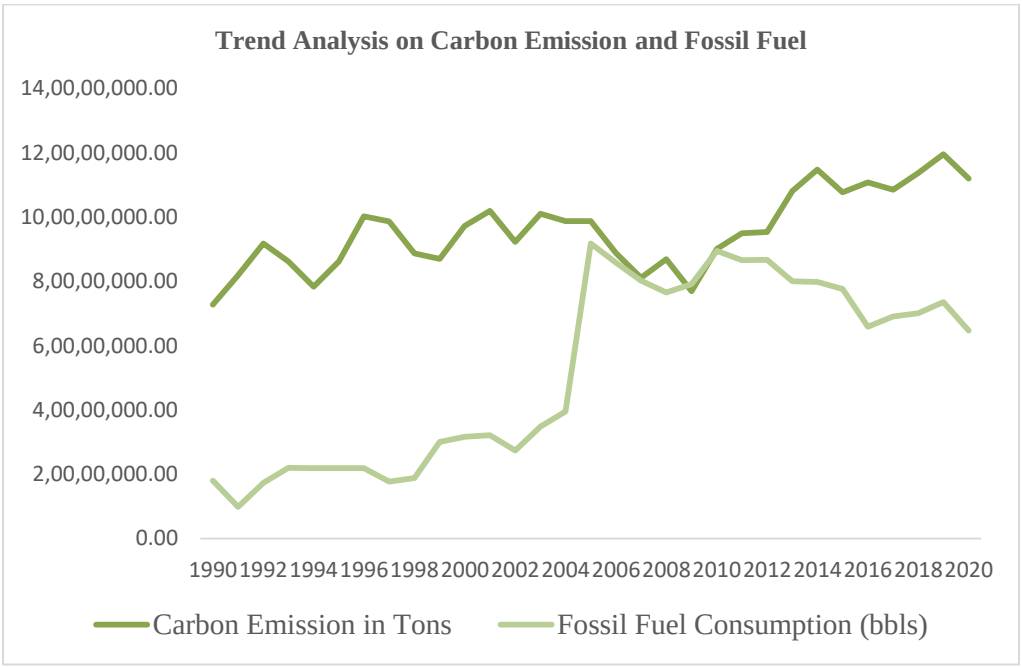

Figure 2: Trend analysis of Carbon Emission and Fossil Fuel

The data presented in Figure 2 above clearly shows an almost proportional upward trend in Carbon Emission and Fossil Fuel consumption. This pattern strongly suggests that there is a direct relationship between these two variables, where an increase in fossil fuel consumption corresponds closely with a rise in carbon emissions. As more fuel is consumed, more carbon is dispersed into the atmosphere. Based on this observed relationship, it is reasonable to conclude that Fossil Fuel consumption plays a pivotal and significant role as the primary contributing factor to the increase in carbon

emissions in Nigeria. In essence, the burning of fossil fuels like coal, oil, and natural gas appears to be a significant contributor to the nation's carbon emissions.

d. Carbon Emission and GDPGR

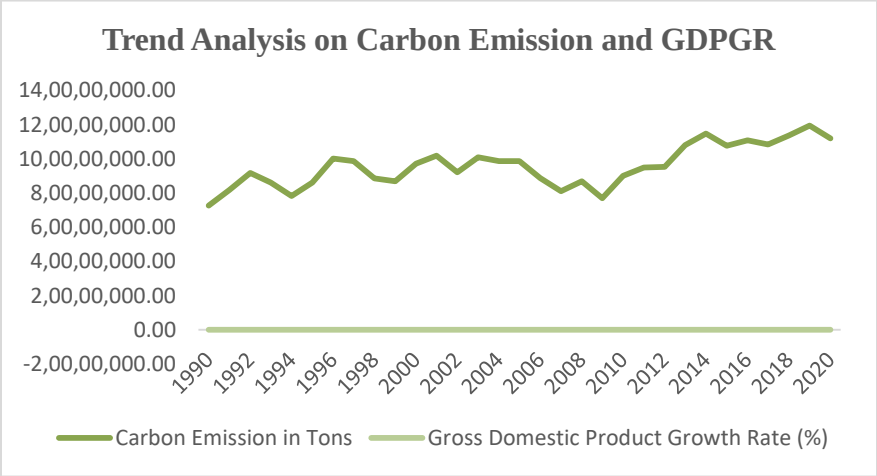

Figure 3: Trend Analysis of Carbon Emission and GDPGR

The data depicted in Figure 3 reveals a clear upward trend in Carbon Emission, while the Gross Domestic Product Growth Rate (GDPGR) exhibits a relatively consistent and almost linear movement. This finding reveals a negative correlation between both variables, indicating that long-term economic growth tends to decline as carbon emission levels rise. In other words, the research suggests that a rise in carbon emissions is linked to unfavourable effects on the economy, as seen by a slower rate of economic growth. As it implies that the environmental cost of excessive carbon emissions can eventually transfer into economic expenses, this negative association raises questions regarding the economic impact of carbon emissions on the environment.

B) Regression Analysis and Interpretations

Table 2: Model Summary

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				

An R-squared value of 0.793 suggests that the variables (GDP growth rate, Fossil fuel, Electricity) can account for approximately 79.3% of the variation in the dependent variable (GDP), leaving around 20.7% unexplained. After further adjustments, the Adjusted R-squared decreases to 77.0%. This indicates that factors such as GDP growth rate, Fossil fuel, Electricity, and other determinants are contributing to the rising carbon emission rate in Nigeria.

Table 3: Anova

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. In other words, there is no statistically significant connection between the GDP rate, fossil fuel use, electricity use, and carbon emission.

Table 4: Coefficients

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

At a threshold of statistical significance of 0.05, the p-values of 0.000 show that the use of fossil fuels, electricity, and the GDP growth rate are all very significant. As a result, the research disproves the null hypothesis, which contends that there is no connection between Nigeria's use of fossil fuels, electricity consumption, GDP growth rate, and carbon emissions. A t-value of 14.585 and p-values of 0.000 support this rejection. In essence, this means that Fossil fuel consumption, Electricity consumption, and GDP growth rate are statistically reliable predictors of the Carbon emission rate in Nigeria.

C) Discussion of Result

According to the data and conclusions, energy use significantly and favourably affects economic growth. This result is consistent with a study by Adenikinju (2016) that looked at how energy use affected economic growth in Nigeria, Singapore, and Indonesia. According to Adenikinju's analysis, these countries' economic growth was significantly impacted by their energy usage. Payne (2009) and Payne & Taylor (2012) reached a consistent conclusion based on their respective research results. The findings derived from the analyses conducted in this study demonstrate that there is a sustained positive correlation between Energy utilisation and Productivity. Additionally, a positive yet detrimental association is observed between Energy and Pollution, which has the potential to negatively impact the overall well-being of the population in terms of health consequences and a decrease in productivity over an extended period of time. According to the empirical findings presented by Chaudhry, Safdar, and Farooq (2012), it was found that the utilisation of electricity as a source of energy has a notable impact on fostering economic development, among other energy sources. The poor impact on economic growth is attributable to the huge amount of oil imports, hence exacerbating the negative effects of oil consumption. The indicator of trade openness also has a good impact on economic growth over the selected time period. In a similar vein, Tang and Tan (2014) looked at the short- and long-term effects of financial development on energy in Malaysia. Shahbaz and Lean (2012) examined Tunisia's energy demand as part of their investigation. The results of their study showed a correlation between financial development and energy consumption, which may be a result of the impact of economic growth. However, over a long period of time, a significant and reciprocal causal relationship between energy use and financial development has been demonstrated.

According to the research done by Chtioui (2012), there is a causal relationship that holds true over the long and short terms between Tunisia's energy consumption and financial growth. Al-Mulali and Sab (2012) research looked at how energy use affects both economic growth and financial development. The results of their research showed that energy consumption is a key factor in promoting both financial and economic development. Xu (2012) investigated the connection between financial development and energy usage in China using panel data and the GMM-system technique. The research was centred on a sample of 29 provinces from 1999 to 2009. The study's conclusions showed a statistically significant positive association between energy use and economic growth. Furthermore, the research by Islam et al. (2013) found that population trends, economic growth, and financial development all significantly contribute to Malaysia's rising energy demand. Over a long period of time, there is evidence that financial growth and energy use are inversely correlated. However, it is evident that financial development has a causal impact on energy demand in the short run.

V. CONCLUSION

Based on the analysis performed, it can be said that there is a statistically significant correlation between Nigeria's use of fossil fuels, power, GDP growth rate, and carbon emission rate. The large t-value (14.585) and high significance levels (p-values of 0.000) suggest that these variables are very important in forecasting the nation's carbon emissions.

A) Recommendations

In order to lessen its reliance on fossil fuels, Nigeria must investigate and invest in alternate and cleaner energy sources given the considerable influence that fossil fuel consumption has on carbon emissions. Additionally, encouraging energy-efficient technology and habits in the use of electricity can help reduce carbon emissions. This can entail making investments

in renewable energy sources and putting energy-saving laws into place. Growth in the GDP is necessary for progress, but it should be achieved in conjunction with environmentally friendly methods. Strengthening and enforcing environmental rules connected to carbon emissions can assist manage and lessen the impact of economic activities on the environment. Policymakers should concentrate on encouraging green and sustainable economic growth in order to offset carbon emissions.

B) Suggestions for Future Studies

Future research can conduct a more extended study to examine how these relationships evolve over time, considering changing economic and environmental policies. Also, a more in-depth analysis by sectors (e.g., industrial, transportation, residential) can provide insights into which areas contribute most to carbon emissions and where mitigation efforts should be targeted. Assessing the effectiveness of specific environmental policies and interventions in Nigeria would help policymakers tailor their strategies for maximum impact.

VI. REFERENCES

[1] Abalaba, B. P., & Dada, M. A. (2013). Energy consumption and economic growth nexus: new empirical evidence from Nigeria. *International Journal of Energy Economics and Policy*, *3*(4), 412-423.

[2] Adaji, J. J., Onolemhemhen, R. U., Isehunwa, S. O., & Adenikinju, A. (2016, December). Forecasting the Domestic Utilization of Natural Gas in Nigeria (2015-2020). In *SPE/AAPG Africa Energy and Technology Conference*. OnePetro.

[3] Ahmad, T., & Zhang, D. (2020). A critical review of comparative global historical energy consumption and future demand: The story told so far. *Energy Reports*, *6(1)*, 1973-1991.

[4] Ajibade, F. O., Adelodun, B., Lasisi, K. H., Fadare, O. O., Ajibade, T. F., Nwogwu, N. A., ... & Wang, A. (2021). Environmental pollution and their socioeconomic impacts. In *Microbe mediated remediation of environmental contaminants* (pp. 321-354). Woodhead Publishing.

[5] Ali, H. S., Law, S. H., & Zannah, T. I. (2016). Dynamic impact of urbanization, economic growth, energy consumption, and trade openness on CO 2 emissions in Nigeria. *Environmental Science and Pollution Research*, *2(3)*, 12435-12443.

[6] Al-Mulali, U., & Sab, C. N. B. C. (2012). The impact of energy consumption and CO2 emission on the economic growth and financial development in the Sub Saharan African countries. *Energy*, *39*(1), 180-186.

[7] Amasyali, K., & El-Gohary, N. M. (2018). A review of data-driven building energy consumption prediction studies. *Renewable and Sustainable Energy Reviews*, *81*, 1192-1205.

[8] Awodumi, O. B., & Adewuyi, A. O. (2020). The role of non-renewable energy consumption in economic growth and carbon emission: Evidence from oil producing economies in Africa. *Energy Strategy Reviews*, *2(7)*, 104-118.

[9] Ayinde, A. R., Celik, B., & Gylych, J. (2019). Effect of economic growth, industrialization, and urbanization on energy consumption in Nigeria: A vector error correction model analysis. *International Journal of Energy Economics and Policy*, *9*(5), 409-418.

[10] Ayinde, A. R., Celik, B., & Gylych, J. (2019). Effect of economic growth, industrialization, and urbanization on energy consumption in Nigeria: A vector error correction model analysis. *International Journal of Energy Economics and Policy*, *9*(5), 409-418.

[11] Bosma, N., Content, J., Sanders, M., & Stam, E. (2018). Institutions, entrepreneurship, and economic growth in Europe. *Small Business Economics*, *5(1)*, 483-499.

[12] Chaudhry, I. S., Safdar, N., & Farooq, F. (2012). Energy consumption and economic growth: Empirical evidence from Pakistan. *Pakistan Journal of Social Sciences*, *32*(2), 371-382.

[13] Chindo, S., Abdulrahim, A., Waziri, S. I., Huong, W. M., & Ahmad, A. A. (2015). Energy consumption, CO 2 emissions and GDP in Nigeria. *GeoJournal*, *8(4)*, 315-322.

[14] Chinedu, U. A., Daniel, O. C., & Ezekwe, U. C. (2019). Impact of energy consumption on economic growth in Nigeria: an approach of time series econometric model. *International Journal of Academic Research in Economics and Management and Sciences*, *8*(2), 65-77.

[15] Chtioui, S. (2012). Does economic growth and financial development spur energy consumption in Tunisia?. *Journal of Economics and International Finance*, *4*(4), 150-164.

[16] Dantama, Y. U., Abdullahi, Y. Z., & Inuwa, N. (2012). Energy consumption-economic growth nexus in Nigeria: An empirical assessment based on ARDL bound test approach. *European Scientific Journal*, *8*(12).

[17] Dogan, E., & Inglesi-Lotz, R. (2020). The impact of economic structure to the environmental Kuznets curve (EKC) hypothesis: evidence from European countries. *Environmental science and pollution research*, *2(7)*, 12717-12724.

[18] Fayiga, A. O., Ipinmoroti, M. O., & Chirenje, T. (2018). Environmental pollution in Africa. *Environment, development and sustainability*, *20(1)*, 41-73.

[19] Frick, S. A., & Rodríguez-Pose, A. (2018). Change in urban concentration and economic growth. *World development*, *1(5)*, 156-170.

[20] García-Martín, E., Rodrigues, C. F., Riley, G., & Grahn, H. (2019). Estimation of energy consumption in machine learning. *Journal of Parallel and Distributed Computing*, *13(4)*, 75-88.

[21] Gill, A. R., Viswanathan, K. K., & Hassan, S. (2018). The Environmental Kuznets Curve (EKC) and the environmental problem of the day. *Renewable and sustainable energy reviews*, *8(1)*, 1636-1642.

[22] Gründler, K., & Potrafke, N. (2019). Corruption and economic growth: New empirical evidence. *European Journal of Political Economy*, *6(1)*, 101-114.

[23] Islam, F., Shahbaz, M., Ahmed, A. U., & Alam, M. M. (2013). Financial development and energy consumption nexus in Malaysia: a multivariate time series analysis. *Economic Modelling*, *30(1)*, 435-441.

[24] Kuznets, S. (2019). Economic growth and income inequality. In *The gap between rich and poor* (pp. 25-37). Routledge.

[25] Ladha-Sabur, A., Bakalis, S., Fryer, P. J., & Lopez-Quiroga, E. (2019). Mapping energy consumption in food manufacturing. *Trends in Food Science & Technology*, *8(6)*, 270-280.

[26] Li, K. X., Jin, M., & Shi, W. (2018). Tourism as an important impetus to promoting economic growth: A critical review. *Tourism management perspectives*, *2(6)*, 135-142.

[27] Liu, K., & Lin, B. (2019). Research on influencing factors of environmental pollution in China: A spatial econometric analysis. *Journal of Cleaner Production*, *20(6)*, 356-364.

[28] Liu, X., Lu, D., Zhang, A., Liu, Q., & Jiang, G. (2022). Data-driven machine learning in environmental pollution: gains and problems. *Environmental science & technology*, *56*(4), 2124-2133.

[29] Maji, I. K. (2015). Does clean energy contribute to economic growth? Evidence from Nigeria. *Energy Reports*, *1(1)*, 145-150.

[30] Manzano, O., & Gutiérrez, J. D. (2019). The subnational resource curse: Theory and evidence. *The Extractive Industries and Society*, *6*(2), 261-266.

[31] Massawe, S., Olorunnisola, A., & Adenikinju, A. (2016). The Environmental Challenges of Biomass Utilisation for Combined Heat and Power Generation in a Paper Mill in Tanzania. *J Fundam Renewable Energy Appl*, *6*(202), 21-36.
[32] McClelland, D. C. (2019). The achievement motive in economic growth. In *the gap between rich and poor* (pp. 53-69). Routledge.
[33] Nathaniel, S. P. (2020). Modelling urbanization, trade flow, economic growth and energy consumption with regards to the environment in Nigeria. *GeoJournal*, *85*(6), 1499-1513.
[34] Ogundipe, A. A., Akinyemi, O., & Ogundipe, O. M. (2016). Electricity consumption and economic development in Nigeria. *International journal of energy economics and policy*, *6*(1), 134-143.
[35] Okoye, L. U. (2021). Analyzing the energy consumption and economic growth nexus in Nigeria. *International Journal of Energy Economics and Policy*, *2*(1), 206-219.
[36] Onifade, S. T. (2022). Retrospecting on resource abundance in leading oil-producing African countries: how valid is the environmental Kuznets curve (EKC) hypothesis in a sectoral composition framework?. *Environmental Science and Pollution Research*, *29*(35), 52761-52774.
[37] Saidi, K., & Hammami, S. (2015). The impact of energy consumption and CO2 emissions on economic growth: Fresh evidence from dynamic simultaneous-equations models. *Sustainable Cities and Society*, *1(4)*, 178-186.
[38] Sedlmeir, J., Buhl, H. U., Fridgen, G., & Keller, R. (2020). The energy consumption of blockchain technology: Beyond myth. *Business & Information Systems Engineering*, *62*(6), 599-608.
[39] Seyedzadeh, S., Rahimian, F. P., Glesk, I., & Roper, M. (2018). Machine learning for estimation of building energy consumption and performance: a review. *Visualization in Engineering*, *6*(1), 1-20.
[40] Shahbaz, M., & Lean, H. H. (2012). Does financial development increase energy consumption? The role of industrialization and urbanization in Tunisia. *Energy policy*, *40*(3), 473-479.
[41] Smith, B., & Waldner, D. (2021). *Rethinking the resource curse*. Cambridge University Press.
[42] Somoye, O. A., Ozdeser, H., & Seraj, M. (2022). The impact of renewable energy consumption on economic growth in Nigeria: fresh evidence from a non-linear ARDL approach. *Environmental Science and Pollution Research*, *29*(41), 62611-62625.
[43] Tang, C. F., & Tan, B. W. (2014). The linkages among energy consumption, economic growth, relative price, foreign direct investment, and financial development in Malaysia. *Quality & Quantity*, *4*(8), 781-797.
[44] Tsai, H. J., Wu, P. Y., Huang, J. C., & Chen, S. C. (2021). Environmental pollution and chronic kidney disease. *International Journal of Medical Sciences*, *18*(5), 112-224.
[45] Vahabi, M. (2018). The resource curse literature as seen through the appropriability lens: a critical survey. *Public Choice*, *175*(3-4), 393-428.
[46] Waheed, R., Sarwar, S., & Wei, C. (2019). The survey of economic growth, energy consumption and carbon emission. *Energy Reports*, *5(1)*, 1103-1115.
[47] Wei, Y., Zhang, X., Shi, Y., Xia, L., Pan, S., Wu, J., ... & Zhao, X. (2018). A review of data-driven approaches for prediction and classification of building energy consumption. *Renewable and Sustainable Energy Reviews*, *8(2)*, 1027-1047.
[48] Xu, S. J. (2012). The impact of financial development on energy consumption in China: based on SYS-GMM estimation. *Advanced materials research*, *5(2)*, 2977-2981.
[49] Xu, S., Yang, C., Huang, Z., & Failler, P. (2022). Interaction between digital economy and environmental pollution: New evidence from a spatial perspective. *International Journal of Environmental Research and Public Health*, *19*(9), 504-521.