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A Retrospective Analysis of the Impact of Different Fuel Consumption Sources on Crude Death Rate in Nigeria

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ABSTRACT

Carbon dioxide (CO2), a crucial gaseous pollutant commonly present in the environment, has been released in substantial quantities in Nigeria due to its heavy reliance on fossil fuels for energy production and consumption across various economic sectors. These elevated levels of CO2 emissions have adverse impacts on both human health and the environment. This study utilized sixty years' worth of CO2 emissions data (1960–2020) sourced from the World Development Indicator (WDI). The data was categorized into different sources of fuel consumption, including solid fuel consumption (SFC), liquid fuel consumption (LFC), and gaseous fuel consumption (GFC). A linear regression analysis was conducted to assess the influence of these three major fossil fuel consumption sources on the crude death rate (per 1000 individuals). The results revealed that all three of these fossil fuel consumption sources significantly contributed to the overall crude death rate in Nigeria, with a p-value of 0.000 for each of the factors examined.

Keywords: Carbon dioxide ($C0_2$), Death rate, Environmental, Fossil fuels, Regression analysis

INTRODUCTION

Carbon dioxide (CO2) plays a vital role as a greenhouse gas, responsible for trapping heat in our atmosphere. It is released into the atmosphere through both natural processes, such as volcanic activity, animal respiration, and plant decay, as well as human activities, primarily the combustion of fossil fuels like coal, oil, and natural gas for energy generation. CO2 is a colourless and odourless gas at typical atmospheric temperatures. This natural greenhouse effect, driven in part by CO2, is essential for maintaining a hospitably warm environment on our planet. However, the excessive release of CO2 from human activities has led to an increase in its atmospheric concentrations, contributing to global warming and disrupting various aspects of Earth's climate. Elevated levels of CO2 can have adverse health effects on individuals exposed to it. These health impacts may encompass symptoms such as headaches, dizziness, restlessness, breathing difficulties, sweating, fatigue, increased heart rate, elevated blood pressure, and in severe cases, can lead to coma or convulsions.

Across both industrialized and developing nations, the expansion of economic activities and technological advancements has led to a substantial boost in economic growth and development. This growth has given rise to new industries and a broader array of industrial operations. Nigeria's economic landscape encompasses various sectors, including industrial, manufacturing, agriculture, finance, education, and tourism. Nevertheless, a significant hurdle confronting these sectors involves the inconsistency in power supply from the national grid, compelling them to rely extensively on petroleum and petrochemical resources as their predominant energy sources to maintain operational continuity. It's important to note that, while these economic sectors contribute significantly to

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the country's GDP, each one has the potential to emit carbon dioxide (CO2) into the atmosphere, contributing to environmental concerns.

[2] investigated the sustainability of alternative energy source, policies that have affected fossil fuels over time was identified, their study acknowledged that we live in a global community and views climate change as a global challenge. In their 2021 study, [3] explored the relationship between ambient air pollution, specifically represented by carbon dioxide (CO2), and mortality rates in Nigeria. They focused on non-accidental, cardiovascular, and respiratory-related deaths from 1970 to 2019. The study utilized time series data sourced from the World Development Indicators and applied an Auto Regressive Distributed Lag Model for analysis. The findings indicated a positive association between CO2 levels and the crude death rate in Nigeria.

[15] asserted that whereas CO2 emissions are a significant by-product of the production of food and energy, they are also the primary cause of climate change. He went on to say that emissions of CO2 are produced by homes, businesses, and farms, among other entities. According to [4], fossil fuels play a major role in the world's economic production. According to his assertion, rising GDP and economic growth result in increased energy consumption and increased CO2 emissions. As remedies, he suggested studying clean energy sources, boosting economic productivity, and making infrastructural investments.[1] asserted that the utilization of energy resources, such as petroleum and electricity, plays a crucial role in fostering economic growth in Nigeria. They noted that coal consumption, on the other hand, did not have a substantial impact on promoting economic growth. Furthermore, their research indicated the presence of a bidirectional causal relationship between energy consumption and long-term economic growth in Nigeria, without discernible evidence of the environment.

According to [6], there was a brief drop in CO2 emissions during the COVID-19 pandemic's early quarantine because there was less of a need for energy. For instance, the need for gas would be substantially reduced if those who work from home were no longer required to fill up their tanks, ESG (environmental, social, and governance) investing is emphasized by [5] as a way to support environmentally conscious businesses and undermine environmentally unfriendly ones.

[12] elaborated on their findings, indicating that characteristics within the neighborhood where children are raised might influence their mortality risks. Cooking fuel, influenced by the socioeconomic background of households, was considered an environmental factor with potential health implications for under-five children. Despite this, the connection between cooking fuel and the health outcomes of such children had received limited attention.

The study aimed to investigate the levels and trends of cooking fuel sources among households in Nigeria and their implied impact on under-five mortality. Data from the Nigeria Demographic and Health Survey (NDHS) Child Recode files of 2003, 2008, and 2013 were utilized. The analysis method employed was descriptive, utilizing cross-tabulation, charts, tables, and the chi-square statistic to assess the significance of associations between variables.

Approximately 80 percent of under-five children lived in homes where wood was used as cooking fuel. The study revealed a highly significant relationship ($P<0.001$) between the type of cooking fuel and under-five mortality in Nigeria. The poorest and poorer households constituted the highest percentage of those using wood and agricultural crop/dung for cooking.

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Environmental factors such as the type of cooking fuel were significantly associated with socioeconomic characteristics of households, including wealth status and place of residence, as discussed in the results. Despite this association, the study found no significant improvement in the source of cooking fuel in households raising under-five children, contributing to their health outcomes. The authors recommended that the Nigerian government prioritize reliable electricity supply for household consumption and make gas fuel available and affordable. Companies are encouraged to be more ecologically and socially conscious when investors support their operations that have good effects on the environment and society. Additionally, he asserts that purchasing green bonds, which are issued to generate funds for environmental preservation, can be crucial in the fight against climate change.Kuznets curve phenomenon.

[10] investigated the influence of carbon emissions on life expectancy in Nigeria. To assess the impact of energy consumption on life expectancy, they employed the Autoregressive Distributed Lag (ARDL) model. The research utilized data from various sources, including the United States (U.S) Carbon Dioxide Information Analysis Centre, the Central Bank of Nigeria (CBN) Statistical Bulletin, International Energy Agency (IEA), and the World Development Indicators (WDI), spanning the years 1980 to 2017. The study's findings indicated, among other things, that carbon emissions had a significant negative effect on life expectancy. In other words, on average, carbon emissions were found to be capable of reducing life expectancy by 0.35%.

The study conducted by [11] delves into the intricate relationship between carbon emissions and life expectancy in Nigeria. The research categorizes emissions from various sources, including gaseous fuel consumption (GFC), liquid fuel consumption (LFC), solid fuel consumption (SFC), transportation (TRA), electricity and heat production (EHP), residential buildings, commercial and public services (RSCPS), “manufacturing industries and construction (MINC), as well as other sectors, excluding residential buildings and commercial and public services (OSEC). The analysis employs a rank-based non-parametric modified Mann–Kendall (MK) statistical approach and a change point detection method to explore sectoral trends. The results revealed that carbon emissions from transportation (TRA) were notably high, followed by LFC. GFC, LFC, EHP, and OSEC displayed a positive Sen’s slope, whereas SFC, TRA, and MINC exhibited a negative Sen’s slope. The trend analysis also indicated multiple changes for TRA and OSEC, while other sources exhibited change points in specific years. These findings provide valuable insights into the sources of CO2 emissions in Nigeria and can inform future environmental planning efforts. In parallel, the study addresses the pressing issue of health outcomes in sub-Saharan Africa, particularly in Nigeria, where infant and under-five mortality rates, although showing some decline, remain persistently high. This is indicative of the overall poor health status of the population. The study further underscores the ongoing challenges associated with fluctuating high levels of carbon dioxide emissions in the region. This is likely due to the increasing reliance on non-renewable” energy sources for economic activities that demand significant energy consumption.

[6] explained how their article focused on the impact of oil production on the human condition in Nigeria. They used environmental degradation, life expectancy, and infant mortality rate as proxies for human condition, “sourcing data from the statistical bulletin of the Central Bank of Nigeria and the World Development Indicator. The study covered the period from 1980 to 2012. They explored the Vector Autoregressive (VAR) model and variance

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decomposition analysis, leading to three key findings, the first period, oil production had a positive impact on environmental degradation, while it was negative in the second period, the lag of oil production in the first period had a positive relationship, while in the second period, it had a negative relationship with life expectancy and variance decomposition analysis revealed that oil production worsened environmental degradation and adversely affected infant mortality rate, yet it had a positive effect on life expectancy. The study recommended two main actions, given the negative impact of oil production on human condition in Nigeria, efforts should focus on controlling carbon emissions by ending gas flaring, especially in the Niger Delta region and that the government should aim to redirect resources from the oil sector towards sustainable policies that enhance the health sector and provide infrastructure such as good roads and clean water, aiming to improve life expectancy. Implementing these suggestions could maximize the positive impact of the oil sector on human condition.

By examining the health implications of environmental quality linked to carbon dioxide emissions in Nigeria from 1980 to 2016, the research employs two health outcome measures and dissects carbon dioxide emissions by sector and the type of fuel consumed. The study employs a bound co-integration approach and an autoregressive distributed lag model to analyse the data. The results, supported by sensitivity analysis, reveal a significant association between aggregate carbon dioxide emissions and both infant mortality and under-five mortality rates. However, when the emissions are disaggregated, carbon dioxide emissions from solid fuel emerge as the primary contributor to adverse health outcomes.

This study aims to construct a model that assesses the impact of carbon dioxide (CO2), including its solid, liquid, and gaseous forms, on Nigeria's crude death rate. The primary objectives are to create a time plot based on the data and to statistically evaluate the significance of the factors under consideration.

MATERIALS AND METHODS

This research“was conducted in Nigeria, a sub-Saharan African nation characterized by an average CO2 emissions per person of approximately 2.8 tonnes. Data pertaining to CO2 emissions in Nigeria were sourced from the World Development Indicators. The study spanned from 1960 to 2020, comprising a total of 60 data points for each of the variables under consideration. Due to data unavailability, the most recent period could not be included in the analysis.

To investigate the impact of various CO2 emissions sources (GFC, LFC, SFC) on Nigeria's crude death rate over a 60-year period, the study employed multiple linear regression.

The model is given as:

$$\delta_{CD} = \gamma_0 + \gamma_1\tau_{GFC} + \gamma_2\tau_{LFC} + \gamma_3\tau_{SFC} \quad (1)$$

The δ_{CD} stands for the crude death rate, τ_{GFC} is the gaseous fuel consumption metric tons per capital, τ_{LFC} is the liquid fuel consumption metric tons per capital, and τ_{SFC} stands for the solid fuel consumption metric tons per capital.

RESULTS AND DISCUSSIONS

In this section, the data analysis was conducted using Stata software, encompassing descriptive statistics, time plots, and inferential statistics.

Table 1 provides the descriptive statistics of the variables under consideration, indicating that the average death rate for the analysed period is 18. Additionally, the mean values for GFC, LFC, and SFC stand at 11086.56, 27820.17, and 385.79, respectively.

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The descriptive statistics of the data is given in the table below

Table 1: The descriptive statistics table

Variable	*Obs*	*Mean*	*Std. Dev.*	*Min*	*Max*
GFC	60	11086.56	10665.91	0	32702.31
LFC	60	27820.17	19497.69	1877.504	70120.38
SFC	60	385.7854	505.6462	7.334	1873.837
DEATHRATE	60	18.73037	3.804108	11.63	26.381

Two Variables Time Plot

Figure 1 illustrate the visual data depicting the patterns in the consumption of Gas fuel and solid fuel for a period of sixty (60) years.

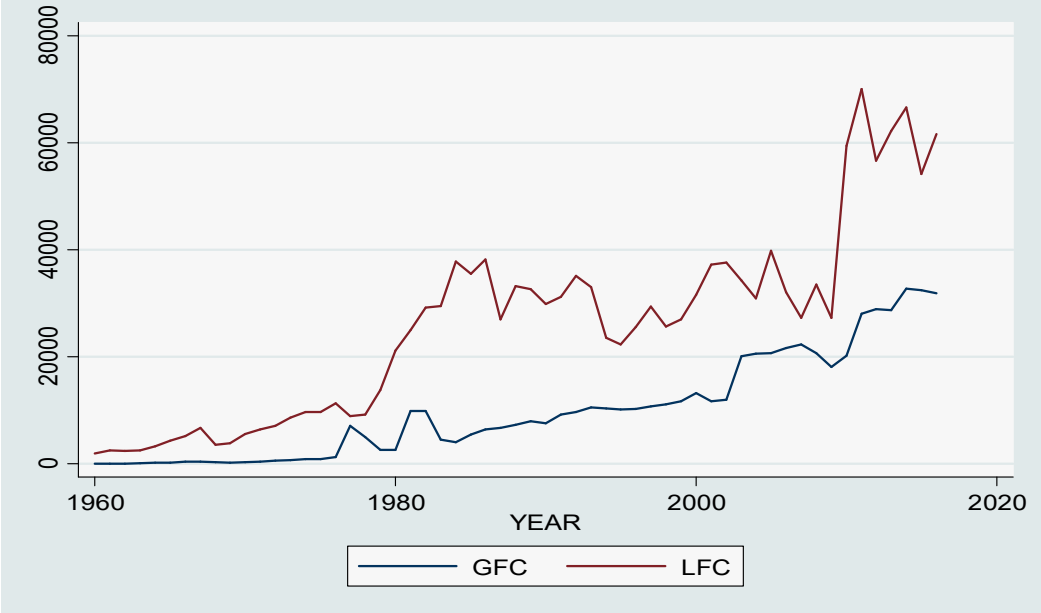

Figure 1: Time plot of GFC and LFC.

The Visual representation in Figure 2 below describe the trends in both gas fuel and solid fuel consumption.

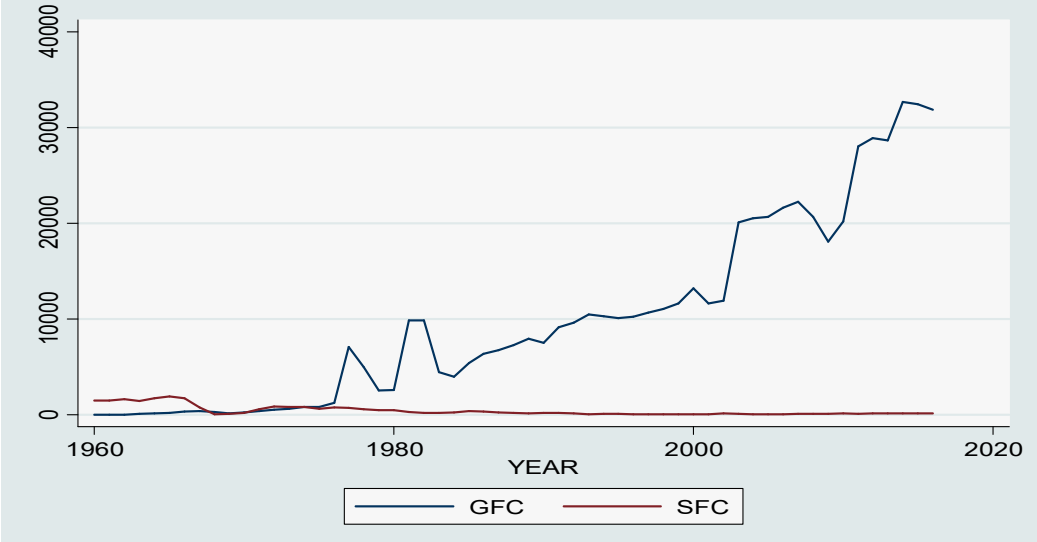

Figure 2: Time plot of GFC and SFC.

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Visual representations in Figure 3 explain the consumption trends of liquid and solid fuels, offering a comprehensive overview of their usage patterns.

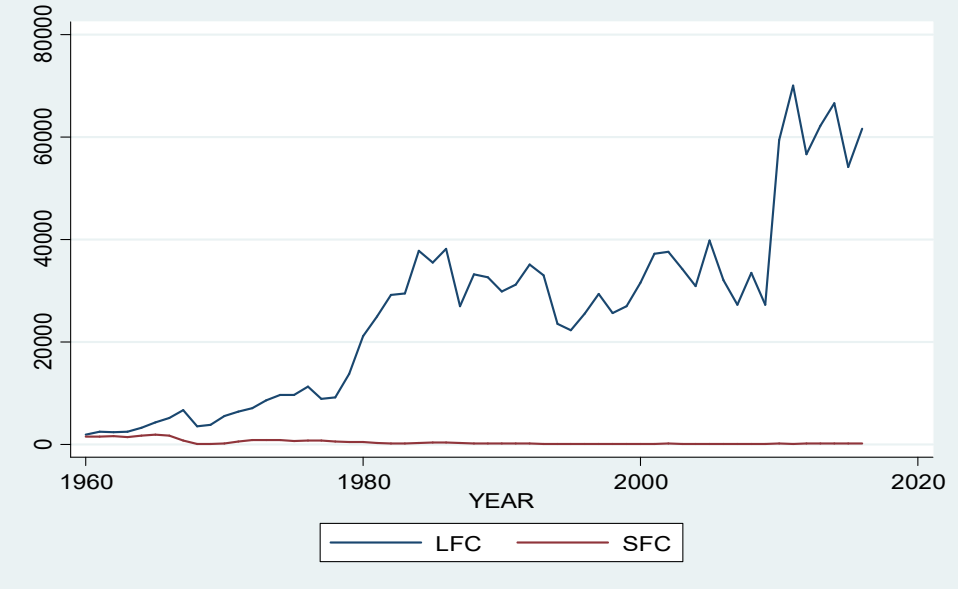

Figure 3: Time plot of LFC and SFC.

Inferential Statistics

Table 2, particularly in the 'p' column, indicates that Gaseous Fuel Consumption (GFC), Liquid Fuel Consumption (LFC), and Solid Fuel Consumption (SFC) make substantial contributions to crude death rate in Nigeria.

Table 2: Parameter Estimates Table

Source	*SS*	*df*	*MS*	*Number of obs*	= 60
Model	808.280376	3	269.426792	F(3, 56)	= 331.44
Residual	45.5225494	56	.812902668	Prob > F	= 0.0000
Total	853.802925	59	14.471236	R-squared	= 0.9467
				Adj R-squared	= 0.9438
				Root MSE	= .90161

Death rate	Coef	Std. Err.	T	P>t	[95% Conf.	Interval]
GFC	-.0001748	.000225	-6.98	0.000	-.000225	-.0001247
LFC	-.0000637	.0000145	-4.39	0.000	-.0000928	-.0000347
SFC	.0019385	.0002962	6.54	0.000	.0013451	.002532
_cons	21.69442	.3269266	66.36	0.000	21.03951	22.34933

The multiple correlation coefficient, denoted as R, stands at 0.9467, signifying a strong predictive capability. Furthermore, the R-squared value (R^2) at 0.9438 indicates that our independent variable accounts for approximately 94.4% of the variability observed in the dependent variable.

The ANOVA table displays an F ratio, indicating that the independent variables provided a statistically significant prediction of the dependent variable, with F(3,56) = 331.44 and a p-value <0.05. This demonstrates that the regression model is a robust fit for the data.

In the coefficient table, the 'Sig' column highlights that Gaseous Fuel Consumption (GFC), Liquid Fuel Consumption (LFC), and Solid Fuel Consumption (SFC) significantly contribute to the crude death rate in Nigeria.

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The model is given as

$$\delta_{CD} = 21.69442 - 0.0001748GFC - 0.0000637LFC + 0.0019385SFC \quad (2)$$

This expounds that with a one-unit increase in Gaseous Fuel Consumption (GFC), there is a corresponding decrease of 0.0001748 in the crude death rate. Similarly, a one-unit increase in Liquid Fuel Consumption (LFC) corresponds to a decrease of 0.0000637 in the crude death rate. On the other hand, a one-unit increase in Solid Fuel Consumption (SFC) corresponds to an increase of 0.0019385 in the crude death rate.

CONCLUSION

This paper discusses the results of data collected from the World Development Indicator (WDI) and analyzed using Stata software. The descriptive statistics shows that GFC, LFC, and SFC significantly contribute to the crude death rate in Nigeria. The multiple correlation coefficient and ANOVA table show that the independent variables provided a statistically significant prediction of the dependent variable. In conclusion, these findings demonstrate that for every one-unit increase in Gaseous Fuel Consumption (GFC), there is a corresponding decrease of 0.0001748 in the crude death rate. Likewise, a one-unit increase in Liquid Fuel Consumption (LFC) correlates with a decrease of 0.0000637 in the crude death rate. Conversely, a one-unit increase in Solid Fuel Consumption (SFC) corresponds to an increase of 0.0019385 in the crude death rate. The model is a robust fit for the data.

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