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ENVIRONMENTAL POLLUTION AND QUALITY OF LIFE IN NIGERIA

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ABSTRACT

The study examined empirically the effect of environmental pollution on quality of life in Nigeria from 1981 to 2020. In order to achieve this, descriptive statistics, unit root test, bound cointegration and ARDL estimation method were employed to analyze the data. The study used Carbon Dioxide Emission (CBEM), Gas Flaring (GAFL), and Particulate Matter 2.5 Emission (PMAT) to capture environmental pollution as the explanatory variables whereas Life Expectancy (LFXP) was used to proxy quality of life as the dependent variable. The result of the revealed that Carbon Dioxide Emission (CBEM) reduces the quality of life in Nigeria, Gas Flaring (GAFL) decrease quality of life in Nigeria, Particulate Matter 2.5 Emission (PMAT) increase quality of life in Nigeria within period of study. The study therefore concluded that Carbon Dioxide Emission (CBEM), and Gas Flaring (GAFL) reduce quality of life in Nigeria within the period under review. The study recommended that government should create employment opportunities for the idle youths so as to take their minds off pipeline vandalization, government should ensure strict compliance of the law on oil spillage and gas flaring in Nigeria. Government should ensure that the host community trust fund is judiciously spent on the victims of oil spillage and gas flaring and fines by defaulting companies should be so exorbitant so as to deter them while the gas can be processed and produced into cooking/domestic gas.

Keywords: Environmental Pollution, Carbon Dioxide Emission (CBEM), Gas Flaring (GAFL), Particulate Matter 2.5 Emission (PMAT), Quality of Life, Nigeria.

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INTRODUCTION

Environmental pollution is one of the major challenges facing humanity in the 21st century. Industrialization, urbanization and developmental projects are the major causes of environmental pollution which is associated with anthropogenic activities have increased within the last century globally (Seiyaboh & Izah, 2019). The different components of the environment (mainly soil, water and air) are frequently impacted by anthropogenic activities and to a lesser extent natural effects. Anthropogenic activities are human activities that are carried out on the earth surface encompassing the various environmental components.

Nearly all human activities are carried out on land. Seiyaboh and Izah (2019) reported that soil is a distinctive habitat for most living organisms. Most of the resources that are widely utilized by humanity are found in the soil. Soil also plays several economic, social, ecological roles. The human activities on soil have direct or indirect effect on soil quality. The impacts also extend to water and air quality. Some of the notable activities that take place in the soil include construction works, erection of building structures, cultivation of vegetation, land transportation among others. As such, soil has been regarded as an integral part of landscape probably due to its diverse and unique characteristics. Soil is formed during weathering processes through the interaction of rock, geologic materials and microorganisms (Ayobami, 2022).

One of the main outcomes of the United Nations Conference on Sustainable Development Goals was the agreement by the Member States to launch a process to develop a set of Sustainable Development Goals (SDGs). The goal 3 "Ensure healthy lives and promote well-being for all at all ages" aims at securing a healthy quality of life for all. A measure to achieve this goal involves substantially reducing the number of deaths and illnesses from hazardous chemicals and air, water, and soil pollution and contamination. The different types of pollution common in Nigeria are: marine pollution, air pollution, land/soil pollution, noise pollution, radiation pollution, light pollution, thermal pollution, etc.

Environmental pollution, contamination of air, water, radio-active emission and soil by human activity is the largest cause of disease and death in low- and middle-income countries (LMICs). The World Health Organization (WHO) estimated that 8.9 million persons die each year of diseases caused by pollution, 8.4 million (94 %) of them in poor countries (Landrigan & Fuller, 2015). Nigeria is one of the countries located within the Sub-Saharan Africa with the population of 170 million people as at 2012 and the population is projected to reach 0.5-1 billion people by 2100 (UN, 2013).

This rapid growth in Nigeria poses a range of environmental concerns as well as air quality. Power generating units are mega projects which require not only huge capital investment but also various natural resources like fossil fuel and water, thus creating immeasurable and extensive impacts on the environment and generate tremendous stress in the local ecosystem. In Nigeria, over 50% of power generated is from thermal power plants (TPP). This however gives an idea of the fact that Nigeria is yet to invest considerably in the area of alternative energy technologies available instead of relying majorly on combustion of fossil fuels for power generation all year round. Most TPP in Nigeria utilize natural gas for their operations.

Man is born with noise and dies with that thus noise is part of human life and a natural product of human environment. Pollutant like smog is a slow agent of death. Noise may not appear as a threat to global environment on the same level as deforestation, hazardous wastes or emission of poisonous gases into the atmosphere but if it continues in the next 30 years as it has for the past 30 years, it could become lethal. Also, marine pollution is classed as point source or

non-point source. Point source pollution occurs when there is a single, identifiable, and localized source of the pollution. That is, "point source" means any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, concentrated animal feeding operation, or vessel or other floating craft, from which pollutants are or may be discharged. An example is directly discharging sewage (i. e. water-carried waste, in solution or suspension, which is intended to be removed from a community, also known as wastewater) and industrial waste into the ocean.

Environmental pollution simply means the introduction, release or addition of any biological, chemical, physical or radiological substance into any of the component parts of the environment (air, water, land or soil) at a rate faster than the rate at which the environment can naturally accommodate it through the process of absorption, dispersion or decomposition (breaking down); and which threatens the life or survival of man, plants and animals or any biotic system of the environment. In other words, environmental pollution is any undesirable change in the biogeochemical processes of the earth that may pose potential danger on the health and survival of humans and other living organisms. That is, any alteration in the physical, chemical or biological characteristics of the air, water or land/soil and that will harmfully affect the survival or activities of man and other flora and fauna or any abiotic system can be viewed as pollution (Ukpere et al., 2018).

Statement of the Problem

The international agreements like the Basel Convention prohibit environmental pollution and the import of hazardous waste but unscrupulous importers and a porous customs system has made Nigeria to rank alongside Ghana as one of the world's leading destinations for electronic waste. The country receives 71,000 tons of used consumer goods through the two main ports in Lagos from the European Union and other more industrialized economies every year. The pollutant gases have been implicated as a major cause of respiratory related impairments. Also, pollutant affects human quality of life because it could cause nose, eye, skin, throat irritation, soil barrenness, offensive odour, cough, breathlessness, dizziness, weakness of the body and predispose the body to certain organ dysfunctions. Some of the indicators or quality of life are adequate human health services available, decent accommodation, decent waste disposal system, safe drinkable water, electricity, telecommunication, education etc. The resultant effect could impact on soil, air and water quality as well as human that reside or work close to the polluted area over a period of time depending on the physical nature of the pollutant as well as its concentration.

Seiyaboh and Izah (2019) examined the impacts of soil pollution on air quality in Nigerian setting. They examined the impact of soil and water pollution on air quality, they strongly believe that soil, water and air pollution are majorly caused by human activities via agricultural practices, industrial activities poor waste management and natural effects such as flooding, acid rain, weathering processes etc. They failed to examine the effect of pollution on man and his quality of life. Secondly, while their work was from 1980-2017, in Nigeria, this work will consider the year 1981-2020 in Nigeria.

Industrialized areas in Nigeria over time have shown an irregular trend in quality of life, some collapsing climax and climate are attributes of environmental pollution. Hence, this research work seeks to bridge the knowledge gap that exists between water pollution, air, and soil pollution in correlation with quality of life in Nigeria.

Aim and Objectives of the Study

The aim of this study is to investigate effect of environmental pollution on quality of life in Nigeria. Specifically, the study is set to:

- Investigate how carbon dioxide emission affects the quality of life in Nigeria.
- Examine how gas flaring affects the quality of life in Nigeria.
- Analyse how particulate matter 2.5 emission affects the quality of life in Nigeria.

Hypotheses

The study is guided by the following null hypotheses.

- **H₀₁**: There is no significant relationship between carbon dioxide emission and the quality of life in Nigeria.
- **H₀₂**: There is no significant relationship between gas flaring and the quality of life in Nigeria.
- **H₀₃**: There is no significant relationship between particulate matter 2.5 emission and quality of life in Nigeria.

LITERATURE REVIEW

Environmental Pollution

Environmental pollution is one of the most significant challenges that the world is facing today. It is the act of contaminating or polluting (either intentionally or accidentally) the natural environment with harmful substances, as a consequence of human activities. There are various types of pollution which affect our lives on a daily basis. The major types include: air pollution, water pollution, and land (soil) pollution. Others include: noise pollution, light pollution, plastic pollution, radioactive/nuclear pollution, thermal pollution, and marine/ocean pollution.

Human activities are the main source of water pollution. The most polluting type includes discharging of industrial waste into water bodies such as lakes and rivers. The harmful chemicals and toxic waste, without being treated, are directly discharged into water bodies. Another source of water pollution is the mixing of untreated sewage with rivers. Polluted and contaminated water from houses is not treated and rather made to enter the water bodies. Yet another example of water pollution is the mixing up of high temperature (hot) water discharge into water bodies at normal temperature. The sudden change and rise in temperature also has a negative impact on aquatic life. Acid rain is also regarded as one of the causes of water pollution.

Air pollution is another major type of environmental pollution. It is the pollution of air by smoke and dangerous gases, chiefly oxides of carbon, sulfur, and nitrogen. Out of the various types of pollution, air pollution is the major contributor to global warming.

Carbon Dioxide Emission and the Quality Of Life in Nigeria

Carbon dioxide emissions are a significant contributor to climate change, with human activities being the primary source of these emissions. The burning of fossil fuels, deforestation, and industrial processes are the main human sources of carbon dioxide emissions. Fossil fuel combustion is the largest contributor, accounting for 87% of human-produced carbon dioxide emissions. Coal, oil, and natural gas are the primary fossil fuels responsible for these emissions. Fossil fuel combustion is the leading human source of carbon dioxide emissions, generating a very high percentage of emissions globally. When fossil fuels such as coal, oil, and natural gas are burned for energy production in power plants, transportation, and industrial facilities, they release carbon dioxide into the atmosphere (Perera, 2017).

In Nigeria, carbon dioxide (CO₂) emissions play a significant role in the country's environmental impact and overall quality of life. Understanding the relationship between CO₂ emissions and quality of life involves examining various aspects such as environmental sustainability, public health, economic development, and social well-being (Olaniyi et al., 2013). Nigeria, like many developing countries, faces challenges related to carbon dioxide emissions due to its reliance on fossil fuels for energy production, industrial activities, transportation, and other sectors. The country's annual CO₂ emissions reflect its industrial growth, urbanization, and energy demands. The per capita emissions in Nigeria indicate the average individual contribution to CO₂ production.

The high levels of CO₂ emissions contribute to global climate change and environmental degradation. In Nigeria, this can lead to adverse effects such as extreme weather events, loss of biodiversity, deforestation, and air pollution (Ogundipe et al., 2020). These environmental impacts can directly affect the quality of life for Nigerian citizens by posing health risks and disrupting ecosystems.

Elevated CO₂ emissions are often associated with increased air pollution, which can have detrimental effects on public health. The high levels of air pollution resulting from CO₂ emissions may lead to respiratory diseases, cardiovascular problems, and other health issues among the population. Poor air quality can reduce life expectancy and overall well-being. The management of CO₂ emissions is crucial for sustainable economic development in Nigeria. Transitioning to cleaner energy sources and implementing eco-friendly practices can enhance economic resilience, create green jobs, attract investments in renewable energy sectors, and improve resource efficiency. Balancing economic growth with emission reduction efforts is essential for long-term prosperity (Olaniyi et al., 2013).

Efforts aimed at addressing carbon footprint and strive for sustainable development goals, have not yielded the needed results. Therefore, it is essential to implement policies that promote clean energy adoption, environmental conservation practices, climate resilience measures, and community engagement in emission reduction efforts. Collaboration at local, national, and international levels is key to achieving a balance between economic growth and environmental protection.

Gas Flaring and the Quality of Life in Nigeria

Gas flaring in Nigeria is a significant environmental and economic issue that has been prevalent since the 1960s when oil companies began production in the country. Nigeria flares approximately 17.2 billion Sm³ (607.2 bscf) of natural gas per year, with an average of 1.4

billion Sm³ per month, as a by-product of crude oil exploration in the Niger Delta region. The practice of gas flaring has numerous environmental impacts, contributing to climate change, acid rain formation, and agricultural degradation. The practice of burning off associated gas during oil production not only leads to economic losses but also poses serious health risks to the population living near flare sites (Mafimisebi & Ogbonna, 2016).

Gas flaring globally results in the burning of almost 140 billion cubic meters (bcm) of natural gas annually, equivalent to nearly 20% of the United States' gas consumption and over 30% of the European Union's gas consumption (Ismail & Umukoro, 2012). The combustion of flared gas releases approximately 350 million tons of CO₂ annually, significantly contributing to greenhouse gas emissions and climate change (Aigbe et al., 2023). Less than 20 countries account for more than 85% of global gas flaring, with four countries alone responsible for about 70bcm of gas flaring (Okafo & Aniche, 2016).

Gas flaring contributes to climate change by emitting CO₂, a potent greenhouse gas with long-term effects on global warming. The increase in atmospheric temperature due to fossil fuel burning poses a severe threat to Nigeria and the world at large (Afinotan, 2022). The Intergovernmental Panel on Climate Change (IPCC) projects a worsening scenario of climate change impacts during the 21st century, with developing countries like Nigeria being particularly vulnerable.

The environmental and economic costs of gas flaring in Nigeria are substantial and the country loses billions of dollars annually due to flaring, which could otherwise be harnessed for energy production. The burning of associated gas releases pollutants into the atmosphere, contributing to climate change and air pollution. This will not only affect the immediate vicinity of the flare sites but also has broader environmental consequences (Nwanya, 2011).

One of the most concerning aspects of gas flaring is its impact on human health. The release of pollutants such as carbon monoxide, carbon dioxide, volatile organic compounds, sulphur dioxide, polycyclic aromatic hydrocarbons, and particulate matter can have severe health effects on individuals living near flare sites. These pollutants can lead to respiratory illnesses, including coughing, respiratory issues, and fever. Children are particularly vulnerable to these health impacts, with higher rates of stunting, wasting, and being underweight observed in communities exposed to high levels of flaring (Mafimisebi & Ogbonna, 2016).

Studies (Mafimisebi & Ogbonna, 2016; Ismail & Umukoro, 2012; Olaniyi et al., 2013) have shown that there are significant positive associations between gas flaring and community-wide rates of various health conditions in Nigeria, and the children living near flare sites are more likely to experience respiratory issues and nutritional deficiencies. The exposure to higher volumes of flaring is linked to increased risks of adverse health outcomes at both individual and community levels.

Particulate Matter 2.5 Emission the Quality of Life in Nigeria

Particulate Matter 2.5 (PM_{2.5}) refers to fine inhalable particles with diameters generally 2.5 micrometers and smaller. These particles are a significant component of particulate matter pollution and have been a focus of environmental and health concerns due to their ability to deeply penetrate the respiratory system and cause adverse effects on human health and the environment (Xing et al. 2016). PM_{2.5} originates from various sources, both natural and anthropogenic. Natural sources include wildfires, volcanic eruptions, and dust storms, while

anthropogenic sources involve activities such as industrial processes, vehicle emissions, construction sites, agriculture, and residential heating using wood or coal.

Particulate Matter 2.5 (PM2.5) emissions have a significant impact on the quality of life in Nigeria, affecting various aspects of health and well-being. PM2.5 refers to fine particles with a diameter of 2.5 micrometers or smaller, which can penetrate deep into the lungs and even enter the bloodstream, leading to a range of health problems (Manisalidis et al., 2020). In Nigeria, where air pollution levels are often high, particularly in urban areas, PM2.5 emissions contribute to respiratory diseases, cardiovascular issues, and overall reduced life expectancy (Pona et al., 2021).

The presence of high levels of PM2.5 in the air poses a serious threat to public health in Nigeria (Lala et al., 2023). These fine particles can cause or exacerbate respiratory conditions such as asthma, bronchitis, and chronic obstructive pulmonary disease (COPD). Additionally, PM2.5 exposure is linked to cardiovascular diseases including heart attacks, strokes, and hypertension. The impact is not limited to adults; children exposed to high levels of PM2.5 are at risk of developing respiratory infections and experiencing stunted lung development. The poor air quality resulting from PM2.5 emissions directly affects the quality of life for individuals in Nigeria. Prolonged exposure to high levels of PM2.5 can lead to decreased lung function, increased hospitalizations due to respiratory illnesses, and a higher prevalence of chronic health conditions among the population. Furthermore, the reduced life expectancy associated with PM2.5 pollution diminishes overall well-being and hinders economic productivity (Pona et al., 2021).

Apart from its impact on human health, PM2.5 emissions also contribute to environmental degradation in Nigeria. These fine particles can settle on surfaces, leading to contamination of soil and water bodies. Moreover, PM2.5 emissions are often associated with other pollutants emitted from vehicles, industries, and biomass burning activities, further exacerbating air quality issues and contributing to climate change (Lala et al., 2023).

Quality of Life

Quality of life is the general well-being of individual, society and corporate entity. Quality of Life (QOL) is an important economic benefit which we are willing to pay for. Economic evaluation is a method for finding out the best value for money in order to allocate resources. Since the traditional measures of QOL, using generic or specific instruments, are of limited use in economic evaluations, it is advisable to include a utility measure. From a research perspective we need to investigate the relationship between different descriptive instruments for QOL, utility score for different health states and willingness to pay for improvements in QOL.

Quality of life (QOL), according to Britannica, is the degree to which an individual is healthy, comfortable, and able to participate in or enjoy life events. The World Health Organization (WHO, 2019) defined QOL as an individual's perception of their position in life in the context of the culture and value systems in which they live and in relation to their goals, expectations, standards and concerns (https://en.wikipedia.org/wiki/Quality_of_life - cite_note-2). Standard indicators of the quality of life include life expectancy, wealth, employment, the pollution free environment, physical and mental health facilities, education, recreation and leisure time, social belonging, religious beliefs, safety, security and freedom, access to clean and drinkable water, adequate waste disposal system, electricity, telecommunication and life expectancy. Quality of life has a wide range of contexts, including the fields of international

development, healthcare, politics and employment. Health related QOL (HRQOL) is an evaluation of QOL and its relationship with health.

Quality of life is a highly subjective measure of happiness that is an important component of many financial decisions. Factors that play a role in the quality of life vary according to personal preferences, but they often include financial security, job satisfaction, family life, health, and safety. Financial decisions can often involve a tradeoff wherein quality of life is decreased in order to save money or earn more money, or, conversely, quality of life can be increased by spending more money (Akinyemi et al., 2012). Quality of life is a non-financial component associated with job and life satisfaction. When used in a work-related way, quality of life often refers to the time and ability to do the thing you enjoy. If a job pays a lot of money but requires so many working hours that the worker cannot enjoy any of the money earned, that is a poor quality of life. If a job provides time to enjoy life but leaves the worker too tired, injured, stressed out, or otherwise unable to enjoy his or her earnings, this is another detriment to the quality of life. It is common today to weigh both salary and quality of life when considering how good or bad a job is.

Workplace conditions are another aspect of quality of life. Different jobs may require workers to perform under extreme exertion such as heavy lifting or repetitive labor that can tax the body over time, possibly leading to long-term physical impairments. Conversely, a job might drastically restrict the movements of the worker because of limited space to perform their tasks, such as staffing a toll booth or a remote security guard station. There are also jobs that can expose employees to potential hazards such as harmful chemicals, heavy machinery, and high-risks of falling or another injury. The possibility for harm that could affect their enjoyment of life is weighed against earning a higher salary provided by an unpleasant job to provide the type of lifestyle the worker desires for themselves and their family members.

THEORETICAL FRAMEWORK

Economic Theory of Environmental Pollution Control by Feldman (1989)

Feldman (1989) noted that welfare or quality of life is maximised in a market economy when there is a perfectly competitive market, full information to make informed choices as citizens and consumers, large numbers of profit maximising firms, clearly assigned property rights and no externalities. However, not unsurprisingly markets rarely enjoy such an appropriate arrangement and therefore on occasion they experience 'market failure'.

Mankiw (1998) defined this concept of market failure as a situation in which a market left on its own fails to allocate resources efficiently. Arguably implicit in this definition is a degree of support for market intervention as a solution. Related to this issue of market failures is the specific concept of externalities. Externalities can be either positive or negative. A positive externality occurs when one person's actions improve the well-being of others, whereas a negative externality will result in a reduction of the welfare of others. Negative environmental externalities occur when the polluter does not fully bear the costs of the damage for which they are responsible. Instead, others in society bear the cost of the negative externalities through a reduction in economic welfare. Such environmental externalities generally arise when environmental resources possess the characteristics of a public good. Environmental resources such as air and water are, by and large, non-market public goods with open-access characteristics and therefore do not generally 'belong' to anyone.

Clinch and Convery (1999) defined the environment as “those parts of our physical and psychological endowment which we somehow share, which are open access”. It is this shared, non-proprietary nature of environmental endowments that threatens their quality and opens them to abuse and misuse. A long tradition of economic theory suggests that treating resources as a commons shared jointly by many users can lead to overexploitation in the absence of some kind of access rationing (Ostrom et al., 2002). Without clear property rights, no incentives exist for careful use or improvement of environmental resources because capturing private gains proves impossible. Thus, externalities are produced and the market fails to allocate the resources efficiently (Ayres & Kneese, 1969). The market failure resulting from negative externalities. The market failure in this example is simply that the polluter is imposing additional costs on others but has no incentive to reduce pollution and produce the socially optimum level of output. Under such circumstances the producer only considers his own private costs and benefits. However, the environmental regulator through the use of pollution control policies, which at least internalise the external social damage, can attempt to correct the sub-optimality of the unregulated market that allows for the existence of these negative externalities.

When pollution control policies are introduced to combat the effects of a negative externality the ultimate goal of this intervention should be to achieve the optimal level of pollution. Welfare economics suggests that the polluter should pay the marginal cost of the environmental damages caused by its activity at the optimal level of pollution. This occurs when the marginal cost of pollution control is equal to the marginal cost of the damage caused by such pollution. Pollution control costs are defined as all monetary expenditure by society, direct or explicit, to reduce current pollution levels, whereas pollution damage costs refer to the monetary value of the damage caused by pollution (Hussen, 2004). The optimal level of pollution is found at the point of intersection of the marginal cost curve of pollution to society and the marginal benefit curve of pollution to the polluter.

METHODS

Research Design

The study adopted the Ex-post facto research design. Ex-post facto study or after-the-fact research is a category of research design in which the investigation starts after the fact has occurred without interference from the researcher. Here the effect of two or more independent variable was investigated. This method allows the researcher to determine the effects of independent variables and also whether they interact in some way as they influence the dependent variable. Ex-post facto research helps the researcher to examine the effect of one variable on another, and thereby tests the hypothesis that a particular factor is responsible for the occurrence of another situation.

The goal of the present study is to seek a detailed understanding of the relationship between environmental pollution and quality of life in Nigeria and to explain the relationship that exists between dependent (quality of life) and independent variables (environmental pollution).

Model Specification

The model specification of this study is in line with the works of Amuka et al. (2018) and Romanus et al. (2021) with a slight modification. Romanus et al. (2021) who studied the effect Carbon Emissions on Life Expectancy in Nigeria modelled:

$$LE = f(\text{CO}_2, \text{FFC}, \text{TEPC}, \text{EH}) \quad (3.1)$$

Where;

LE = life expectancy

CO₂ = emissions of Carbon dioxide

FFC = consumption of energy from fossil fuel

TEPC = total electric power consumption

EH = government health expenditure

Amuka et al. (2018) who examined the effect of Climate change and Life Expectancy in a Developing Country: Evidence from Greenhouse Gas (CO₂) Emission in Nigeria

$$LE = f(\text{CDF}, \text{CO}_2, \text{IMU}, \text{PC}, \text{SANI}, \text{HEP}) \quad (3.2)$$

Where:

LE = Life expectancy,

CDF=Caloric deficiency,

CO₂=Carbon dioxide emission,

IMU=Immunization,

PC=Per capita income,

SANI=Sanitation,

HEP=Health expenditure per capita

However, the present study deviates from these studies by examining the effect of environmental pollution on quality of life in Nigeria by using life expectancy to proxy the quality of life as the dependent variables whereas Carbon Dioxide Emission (CBEM), Gas Flaring (GAFL), and Particulate Matter 2.5 Emission (PMAT),

Hence, the functional relationship of the models will be:

$$\text{LFXP} = f(\text{CBEM}, \text{GAFL}, \text{PMAT}) \quad (3.3)$$

From equations (3.3), the mathematical form of the models is specified as:

$$\text{LFXP} = \beta_0 + \beta_1 \text{CBEM} + \beta_2 \text{GAFL} + \beta_3 \text{PMAT} \quad (3.4)$$

From equations (3.4), the econometric form of the models is specified as:

$$\text{LFXP}_t = \beta_0 + \beta_1 \text{CBEM}_t + \beta_2 \text{GAFL}_t + \beta_3 \text{PMAT}_t + \mu \quad (3.5)$$

Where;

LFXP = Life Expectancy a proxy for quality of life

CBEM = Carbon Dioxide Emission

GAFL = Gas Flaring

PMAT = Particulate Matter 2.5 Emission

Where; β_0 is the intercepts

$\beta_1 - \beta_5$ are the coefficients of independent variables

t = Time t

while μ_1 is the error terms.

Theoretical Expectations

On a prior ground, we expected the following signs of the coefficients of the explanatory variables

$$\beta_1 < 0, \beta_2 < 0, \text{ and } \beta_3 < 0.$$

The implication of the above signs of the parameter estimates is that, we expect a negative relationship between each of the explanatory variables and the dependent variable.

Explanation of the Variables in the Model

Dependent Variables

In this study, life expectancy (LFXP) a proxy for quality of life is the dependent variables in the models.

Life Expectancy (LXP)

Life expectancy refers to the number of years a person is expected to live base on the statistical average. Life expectancy varies by geographical area and by era. Life expectancy at birth reflects the overall mortality level of a population. It summarizes the mortality pattern that prevails across all age groups in a given year – children and adolescents, adults and the elderly.

Independent Variables

In this study, Carbon Dioxide Emission (CBEM), Gas Flaring (GAFL), and Particulate Matter 2.5 Emission (PMAT),

Carbon Dioxide Emission (CBEM)

Carbon dioxide emission is released into Earth's atmosphere mostly by the burning of carbon-containing fuels and the decay of wood and other plant matter. Under all conditions found naturally on Earth, CO₂ is an invisible, odorless gas. It is removed from the atmosphere mostly by plants, which extract carbon from CO₂ to build their tissues, and by the oceans, in which CO₂ dissolves.

Because CO₂ is opaque to infrared radiation (the electromagnetic waves emitted by warm objects) in the atmosphere, it acts as a blanket to slow the loss of heat from Earth into space. Although other gases are also causing Earth's climate to warm, CO₂ alone is responsible for about three-fourths of global warming.

The amount of CO₂ in the atmosphere has increased greatly since human beings began burning large amounts of coal and petroleum in the nineteenth century. In more recent times, this source of CO₂ emissions has increased rapidly, while destruction of forests has also become a major source of CO₂. Carbon dioxide emissions impact human health by displacing oxygen in the

atmosphere. Breathing becomes more difficult as carbon dioxide levels rise. Carbon dioxide levels may indicate high levels of other harmful air pollutants such as volatile organic compounds which contribute to indoor air pollution. It is expected that an increase in CO₂ emission will decrease the quality of life. Thus, $dLFXP/dCBEM < 0$.

Gas Flaring (GAFL)

Gas flaring is the burning of natural gas that is associated with crude oil when it is pumped up from the ground. In petroleum-producing areas where insufficient investment was made in infrastructure to utilize natural gas, flaring is employed to dispose of this associated gas. Also, chemical factories, oil refineries, oil wells, rigs and landfills, gaseous waste products and sometimes even non-waste gases produced are routed to an elevated vertical chimney called a gas flare and burnt off at its tip. This is called gas flaring. Waste gases are subjected to such a process either because the gases are waste or it is difficult to store and transport them. Non-waste gases are burnt off to protect the processing equipment when unexpected high pressure develops within them. Gas flaring in oil rigs and wells contribute significantly to greenhouse gases in our atmosphere.

According to Ismail and Umukoro (2012), the implication of gas flaring on human health are all related to the exposure of those hazardous air pollutants emitted during incomplete combustion of gas flare. These pollutants are associated with a variety of adverse health impacts, including cancer, neurological, reproductive and developmental effects. Deformities in children, lung damage and skin problems have also been reported. It is expected that an increase in gas flaring will decrease the quality of life. Thus, $dLFXP/dGAFL < 0$.

Particulate Matter 2.5 Emission (PMAT)

Particulate matter (PM) is a term used to describe the mixture of solid particles and liquid droplets in the air. It can be either human-made or naturally occurring. Some examples include dust, ash and sea-spray. Particulate matter (including soot) is emitted during the combustion of solid and liquid fuels, such as for power generation, domestic heating and in vehicle engines. Particulate matter varies in size (i. e. the diameter or width of the particle). PM_{2.5} means the mass per cubic metre of air of particles with a size (diameter) generally less than 2.5 micrometres (µm). PM_{2.5} is also known as fine particulate matter (2.5 micrometres is one 400th of a millimetre).

The biggest impact of particulate air pollution on public health is understood to be from long-term exposure to PM_{2.5}, which increases the age-specific mortality risk, particularly from cardiovascular causes. Exposure to high concentrations of PM (e. g. during short-term pollution episodes) can also exacerbate lung and heart conditions, significantly affecting quality of life, and increase deaths and hospital admissions.

It is expected that an increase in PM_{2.5} emission will decrease the quality of life. Thus, $dLFXP/dPMAT < 0$.

DATA PRESENTATION

The time series plots of the variables used in this study such as Nigeria's Life Expectancy (LFXP), Carbon Dioxide Emission (CBEM), Gas Flaring (GAFL), and Particulate Matter 2.5 Emission (PMAT), between 1981 and 2020 are shown and presented in Tables below.

Table 1: Data Presentation

YEAR	LFXP (Years)	CBEM (Metric tons per capita)	GAFL (Billion standard cubic feet)	PM2.5 (Microgram per cubic meter)
1981	45.637	0.847278	13470	0
1982	45.867	0.754642	11940	0
1983	46.023	0.854836	11948	0
1984	46.106	0.836413	12813	0
1985	46.127	0.857037	13922	0
1986	46.101	0.673985	13917	0
1987	46.048	0.782645	12194	0
1988	45.99	0.457407	14740	0
1989	45.939	0.411675	18784	0
1990	45.9	0.432827	22410	81.46689
1991	45.875	0.465396	24660	81.46689
1992	45.857	0.439501	24575	81.46689
1993	45.845	0.334299	25770	81.46689
1994	45.843	0.312014	26910	81.46689
1995	45.854	0.334795	26986	77.88861
1996	45.88	0.363799	26590	77.88861
1997	45.923	0.326916	24234	77.88861
1998	45.994	0.334168	23632	77.88861
1999	46.103	0.647043	22362	77.88861
2000	46.267	0.693956	24255	74.50545
2001	46.51	0.735533	1000.74	74.50545
2002	46.835	0.760558	920.92	74.50545
2003	47.242	0.731582	801.46	74.50545
2004	47.72	0.76419	851.64	74.50545
2005	48.252	0.689211	805.51	59.98227
2006	48.812	0.648278	820.42	59.98227
2007	49.373	0.638768	816.64	59.98227
2008	49.913	0.492981	670.98	59.98227
2009	50.422	0.720175	526.36	59.98227
2010	50.896	0.808855	544.72	51.52977
2011	51.346	0.711653	503.94	53.37225
2012	51.786	0.723832	465.25	50.09322
2013	52.228	0.737683	427.97	46.39325
2014	52.672	0.640003	393.83	41.60273
2015	53.112	0.647285	330.93	115.124
2016	53.541	0.67499	288.91	122.4784
2017	53.95	0.654093	337.89	93.07
2018	54.332	0.658789	282.08	72.85559
2019	54.687	0.662624	425.9	72.00788

2020	54.323	0.658502	981.12	79.31116
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Note: (i) *LFXP* = Life Expectancy,
(ii) *CBEM* = Carbon Dioxide,
(iii) *GAFL* = Gas Flaring,
(iv) *PMAT* = Particulate Matter (PM) that have a diameter of less than 2.5,

Source: NNPC Annual Statistics (various Issues) and World Development Indicators.

Figure 1 shows that life expectancy has been on the increase in Nigeria within the period under review. It increased steadily from 45.567 in 1981 to 45.9 in 1990 to 46.267 in 2000 to 50.896 in 2010 and to 54.323 in 2020 as shown in figure in figure 1.

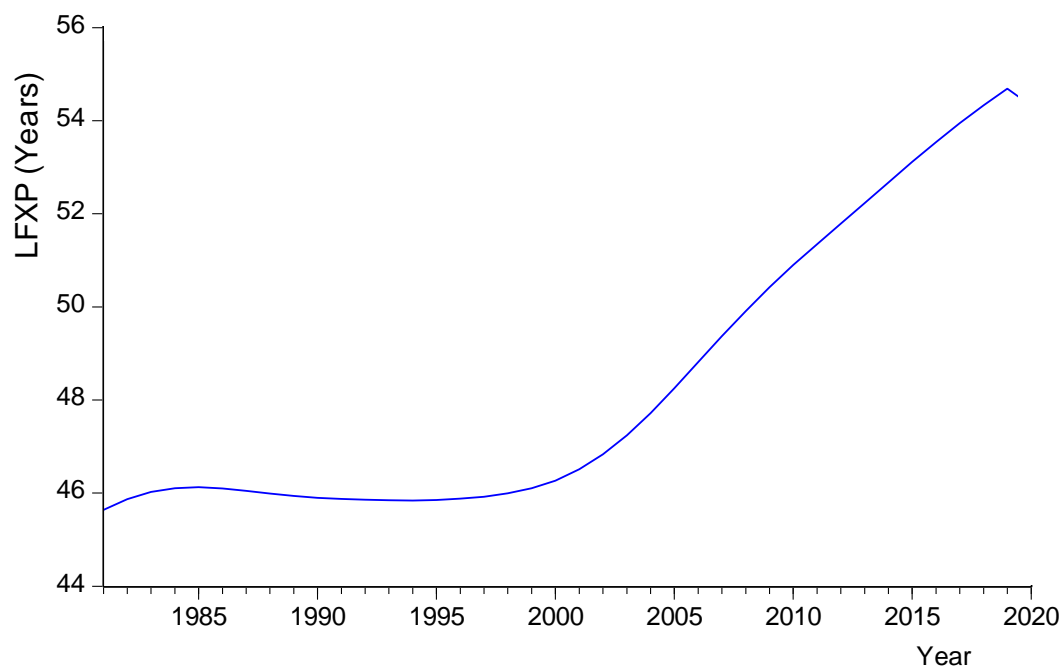


Figure 1: Time Series Plot of Nigeria's LFXP (1981-2020)

Table 1 and Figure 2 shows that carbon emission (CEM) in Nigeria between 1981 and 2020 is in puzzle form with fundamental strong up and down spike. It increased from 1981 to 1987 and undulating till 2020 as shown in Figure 2.

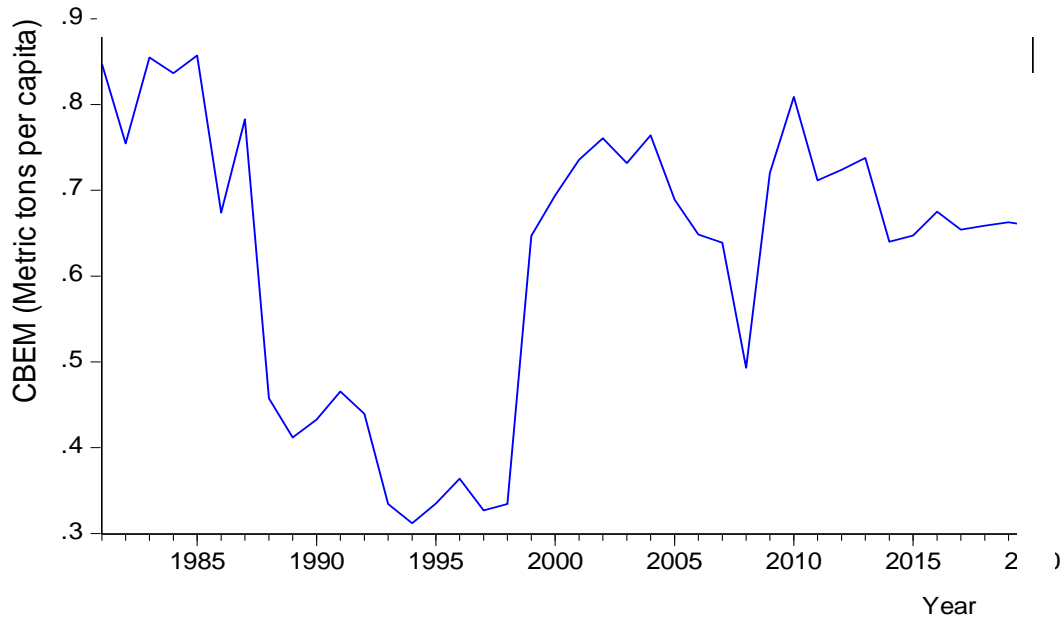


Figure 42: Time Series Plot of Nigeria's CBEM (1981-2020)

Again, the table shows that gas flaring in Nigeria increased from 1981 to its peak in 1996 and later dropped down steadily to 2001 and to 2020 as shown in Figure 3.

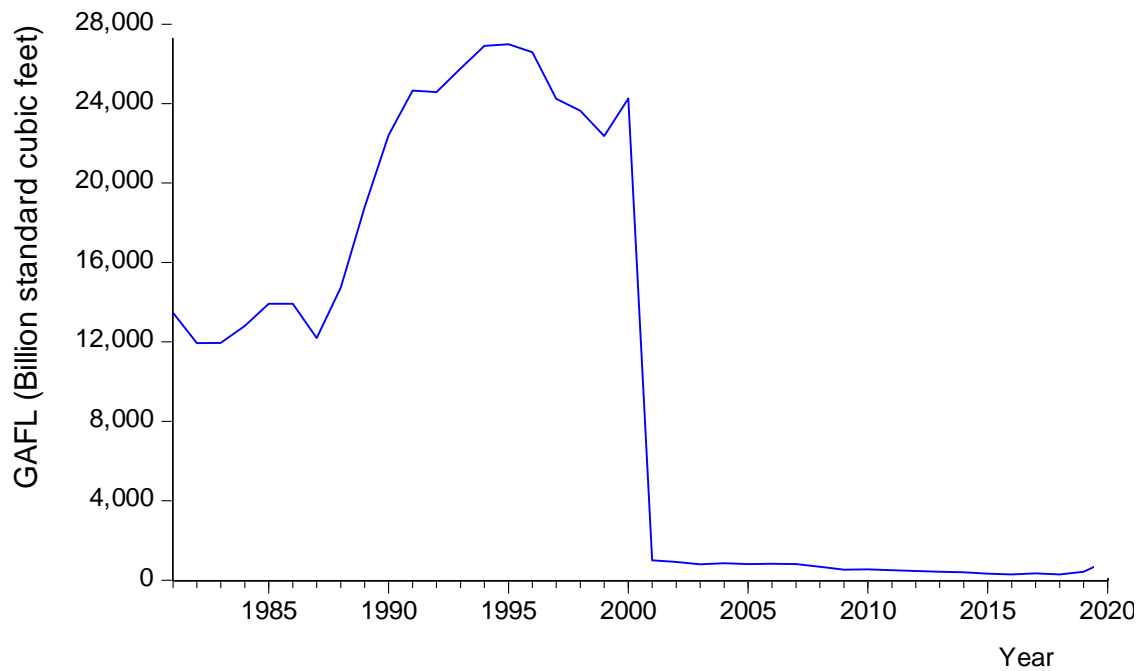


Figure 3: Time Series Plot of Nigeria's GAFL (1981-2020)

Also, the table shows that PM2.5 in Nigeria moved up and down in a decreasing form from 1990 to its lowest value in 2014 and rise the following year to its peak in 2016 and fell down again till 2020 as shown in Figure 4.

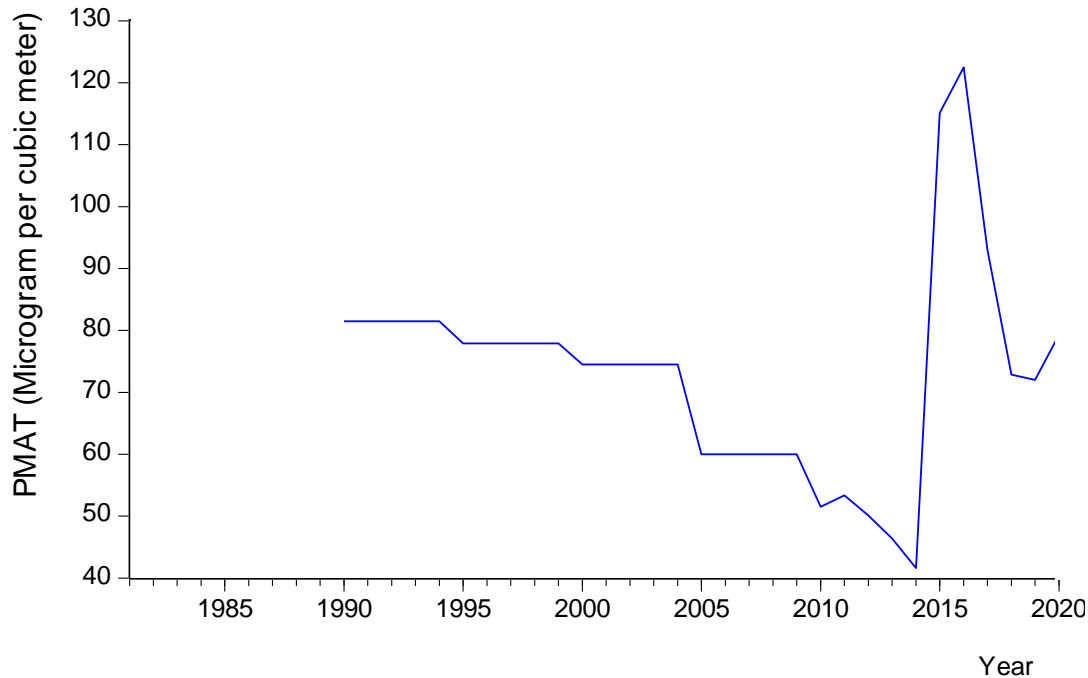


Figure 4: Time Series Plot of Nigeria's PMAT (1981-2020)

Descriptive Statistics Results

The analysis of the data was done using the E-view computer software version 9.0. It was analyzed based on equations in chapter three. In order to have a viable analysis between the variables, it begins with descriptive analysis.

Table 2: Descriptive Statistics Test Result

	LFXP	CBEM	GAFL	PMAT
Mean	48.42828	0.623005	10207.73	73.13079
Median	46.38850	0.660707	6470.370	74.50545
Maximum	54.68700	0.857037	26986.00	122.4784
Minimum	45.63700	0.312014	282.0800	41.60273
Std. Dev.	3.135288	0.167398	10560.92	17.38474
Skewness	0.812688	-0.588078	0.402930	0.735146
Kurtosis	2.074212	2.097770	1.490103	4.346531
Jarque-Bera	5.831550	3.662271	4.881998	5.134251
Probability	0.054162	0.160231	0.087074	0.076756
Sum	1937.131	24.92022	408309.2	2267.054
Sum Sq. Dev.	383.3713	1.092860	4.35E+09	9066.874
Observations	40	40	40	31

Source: Authors Computation (2022)

The result of the descriptive statistics in Table 2 above shows that LFXP has a mean value of 48.42828 and ranges from 45.63700 to 54.68700 with a standard deviation of 3.135288. The skewness value of LFXP is positive (0.812688), meaning that LFXP has a long-right tail while the kurtosis value of LFXP is 2.074212 (i. e. less than 3), meaning that it is platykurtic. That is, it has a flat distribution, meaning that the series has a low value lower than the mean sample.

CBEM has a mean value of 0.623005 with a standard deviation of 0.167398 and ranges from 0.312014 to 0.857037. The skewness value of CBEM is positive (0.588078), meaning that CBEM has a long-right tail while the kurtosis value of CBEM is 2.097770 (i. e. less than 3), meaning that it is platykurtic. This means that the series has a lower value below the sample mean, that is, it has a flat distribution or surface.

GAFL has a mean value of 10207.73 and ranges from 282.0800 to 26986.00 with a standard deviation of 10560.92. The skewness value of GAFL is positive (0.402930), meaning that GAFL has a long-right tail while the kurtosis value of GAFL is 1.490103 (i. e. less than 3), meaning that it is platykurtic. This means that the series has a lower value below the sample mean, that is, it has a flat distribution or surface.

PMAT has a mean value of 73.13079 and ranges from 41.60273 to 122.4784 with a standard deviation of 17.38474. The skewness value of PMAT is positive (0.735146), meaning that PMAT has a long-right tail while the kurtosis value of PMAT is 4.346531 (i. e. less than 3), meaning that it is platykurtic. This means that the series has a lower value below the sample mean, that is, it has a flat distribution or surface.

Based on these observations, it is therefore necessary to test for the stationarity of the variables and the long run relationship since using the variables at level might give a spurious result. The unit root test is conducted so as to make the variables stationary. The study adopts the Augmented Dickey Fuller (ADF) unit root test procedure.

Unit Root Results Analysis

The ADF result for the variables – Life Expectancy (LFXP), Carbon Dioxide Emission (CBEM), Gas Flaring (GAFL), and Particulate Matter 2.5 Emission (PMAT) used in this study are presented in tables 3 below. The Augmented Dickey Fuller (ADF) was tested with intercept and no trend.

Table 3: ADF Unit Root Tests Results

Variable	ADF at Level	ADF Critical Value	ADF at 1 st Difference	ADF Critical Value	Status	Remark
LOG(LFXP)	0.0.899970	-2.943427	-3.309765	-2.941145	I(1)	Stationary
CDEM	2.207619	-2.938987	-7.007858	-2.941145	I(1)	Stationary
LOG(GAFL)	-0.965173	-2.938987	-5.676194	-2.941145	I(1)	Stationary
LOG(PMAT)	-2.596298	-2.963972	-5.137192	-2.967767	I(1)	Stationary

Source: *Extract from Appendix using E-view version 9.0 software*

The result of the unit root test in Table 3 revealed that variables was stationary at level while LFXP, CBEM, GAFL, and PMAT were stationary at 1st difference. The result depicts that the independent variables used in model one were integrated of both order zero and one, that is, I(1) and I(0) and the dependent variable is integrated of order one, that is, I(1). Since the ADF results

indicate that the series are of mixed order of integration, we cannot use the Engle-Granger and Johansen co-integration tests but rather the appropriate test to use in this study is the Bounds co-integration test. When the series used in any study are of different order of co-integration, the appropriate test to use is the bound co-integration test.

Short Run Estimation Results

The results of both the short run dynamics estimation of model is presented in table 4.5 below.

Table 4: ARDL Short Run Estimation Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(LFXP(-1))	0.768938	0.256166	3.001718	0.0070
D(CBEM)	-0.244258	0.260050	-0.939274	0.3588
D(CBEM(-1))	1.052468	0.392311	2.682739	0.0143
DLOG(GAFL)	-0.212405	0.056928	-3.731137	0.0013
DLOG(PMAT)	0.107045	0.108894	0.983019	0.3373
ECM (-1)	-0.350041	0.098625	-3.549203	0.0020
Adj-R2 = 0.679759; F-stat. = 7.155680 (f-prob. = 0.000132); DW = 1.861381				

Source: Authors Computation using E-view 9

From Table 4, the result shows that the ECM included in this model has the right sign (i. e. negative) and is statistically significant at 5 percent level. The coefficient indicates a low adjustment speed of about 35 percent. This adjustment implies that 35 per cent of errors are corrected within one year since that data were annual series. The ECM also reveals that a long run relationship exists between the regressors (CBEM, GAFL, and PMAT) and the response variable (LFXP) in this model. The findings confirmed that a short run relationship exist among the variables in the model.

Furthermore, the calculated Adj-R² is 0.679759. This means that about 68 per cent of the total variations in LFXP are caused by the explanatory variables CBEM, GAFL, and PMAT,. Thus, the remaining 32 per cent of variations is caused by exogenous factors to the model but covered by the error term. Also, the F-statistics calculated of 7.155680 with a probability value 0.000132 which is less than 0.05 level of significance, means that the overall model is significant at 5 per cent level. The value of the D.W is 2.3681381 suggests that there is minimal serial autocorrelation in the model.

The coefficient of past lag 1 value of CBEM and PMAT has a positive relationship with quality of life (LFXP) while current value of CBEM and GAFL has a negative relationship with quality of life (LFXP) in Nigeria within the period under review.

Long-Run Estimation Results

Table 5 shows the estimated coefficients of the long run relationship between the variables in the model.

Table 5: ARDL Long Run Estimation Result

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CBEM	-15.608730	5.061386	-3.083885	0.0059
LOG(GAFL)	-2.533697	0.730275	-3.469509	0.0024
LOG(PMAT)	1.276894	1.318271	0.968613	0.3443
LOG(ANXD)	0.518178	4.400853	0.117745	0.9074
LOG(OSPL)	-0.975901	0.333043	-2.930255	0.0083
C	77.425752	50.820820	1.523505	0.1433

Source: Authors Computation using E-view 9

From Table 5 the result of the long run estimation shows that CBEM and GAFL has a negative and a significant effect on LFXP. The coefficient of ANXD has positive relationship with LFXP and are not statistically significant with LFXP at 5 percent level of significance in Nigeria in the long run within the period under review.

Diagnostic Testing

The researcher also conducted a diagnostic test to ascertain whether or not the series are free from linearity (Ramsey Reset Test), autocorrelation (Breusch-Godfrey Serial Correlation LM Test), heteroscedasticity (Breusch-Pagan-Godfrey Test). The result of the diagnostic test is presented in Table 6 below.

Table 6: Ramsey Reset Test, Serial Correlation LM Test and Homoscedasticity Test Results

	F-Statistic	Prob. Value
Ramsey Reset Test	0.012862	0.9109
Breusch-Godfrey Serial Correlation LM Test	0.924626	0.4093
Breusch-Pagan-Godfrey Heteroskedasticity Test	1.053303	0.4135

Source: Authors Computation using E-view 9

From Table 6 above, the results of the diagnostic test shows that the linearity test using Ramsey reset test indicates that the f-statistic is 0.012862 with a computed p-value of 0.7202 which is greater than 5 percent (0.05) critical value rejects the null hypothesis and conclude that the model is correctly specified. The result of the serial or autocorrelation test using Breusch-Godfrey Serial Correlation LM Test shows that the f-statistic is 0.924626 with a Chi-Square probability value is 0.4093. This indicates that the probability value of about 41 percent (0.4093) is greater than 5 percent (0.05) critical value; hence we confirm no serial correlation in the model. The result of the heteroscedasticity test using Breusch-Pagan-Godfrey test shows that the f-statistic is 1.053303 while the Chi-Square probability value of 0.1993. The result suggests that there is no evidence of heteroskedasticity in the model since the probability Chi-square value is more than 5 percent ($P > 0.05$). So, residuals do have constant variance which is desirable in regression meaning that residuals are Homoscedastic.

DISCUSSION OF FINDINGS

Carbon Dioxide Emission and Quality of Life in Nigeria

The study revealed that coefficients of carbon dioxide emission (CBEM) has a negative (-15.608730) relationship with the quality of life in the long run. This implies that a unit increase in carbon dioxide emission (CBEM) will reduce quality of life by 15.608730 units in Nigeria in the long run within period of study. The negative sign of carbon dioxide emission (CBEM) conforms to a prior expectation in line with economic theory.

The negative relationship between carbon dioxide emission (CBEM) and quality of life disagrees with the finding of Amuka et al. (2018) who found that carbon dioxide emission (CBEM) did not reduce the quality of life but supports the findings of Apte et al. (2018), Osabohien et al. (2019), Romanus et al. (2021), Oyelade et al. (2022). These scholars have found that carbon dioxide emission (CBEM) reduces the quality of life of countries.

The coefficient of carbon dioxide emission (CBEM) is statistically significant with quality of life at 5 per cent level. This is because the p-value calculated of 0.0059 is less than p-table value of 0.05. The study rejects null hypothesis as there is no significant relationship between carbon dioxide emission (CBEM) and quality of life in Nigeria but do not reject the alternative hypothesis within period of study.

It is expected that carbon dioxide emission (CBEM) will reduce the quality of life and this study confirm that carbon dioxide emission (CBEM) has negative effect on quality of life in Nigeria.

Gas Flaring and Quality of Life in Nigeria

The study reveals that coefficient of gas flaring (GAFL) has a negative (-2.533697) relationship with quality of life in the long run. This implies that increase in gas flaring (GAFL) will decrease quality of life in Nigeria within period of study. The negative sign of gas flaring (GAFL) conforms to a priori expectation in line with economic theory.

The negative relationship between gas flaring (GAFL) and quality of life agrees with the findings of Ajugwo (2013) who found that gas flaring (GAFL) reduces the quality of life of countries. The coefficient of gas flaring (GAFL) is statistically significant with quality of life at 5 per cent level. This is because the p-value calculated of 0.0024 is less than p-table value of 0.05. The study rejects null hypothesis as there is no significant relationship between gas flaring (GAFL) and quality of life in Nigeria within period of study but do not reject the alternative hypothesis. It is expected that gas flaring (GAFL) will reduce the quality of life and this study confirm that gas flaring (GAFL) has negative effect on quality of life in Nigeria.

Particulate Matter (PM_{2.5}) and Quality of Life in Nigeria

The study revealed that coefficient of Particulate matter (PM_{2.5}) has a positive (1.276894) relationship with quality of life in the long run. This implies that an increase in Particulate matter (PM_{2.5}) increases the quality of life in Nigeria within period of study. The positive sign of Particulate matter (PM_{2.5}) do not conform to a priori expectation in line with economic theory.

The positive relationship between Particulate matter (PM2.5) and quality of life disagrees with the findings of Apte et al. (2018), Xing et al. (2016), Lala et al., (2023) and Schwartz et al. (2018) who found that Particulate matter (PM2.5) reduces the quality of life of countries.

The coefficient of Particulate matter (PM2.5) is not statistically significant with quality of life at 5 per cent level. This is because the p-value calculated of 0.3443 is greater than p-table value of 0.05. The study accepts null hypothesis as there is no significant relationship between Particulate matter (PM2.5) and quality of life in Nigeria within period of study.

The positive and insignificant effect of Particulate matter (PM2.5) on quality of life may suggest that Particulate matter (PM2.5) is not a threat to the quality of life and longevity in Nigeria but may be other factors like per capital health spending (HEP), improvement in sanitary practice and immunization of the child hold the key to longevity, especially in Nigeria or the provision of adequate health care services that has been a lingering problem in the country with public health institutions running shortage of skilled workforce as well as essential drugs and amenities.

CONCLUSION

The study examined empirically the effect of environmental pollution on quality of life in Nigeria from 1981 to 2020. In order to achieve this, descriptive statistics, unit root test, bound cointegration and ARDL estimation method were employed to analyze the data. The result of the ARDL revealed that Carbon Dioxide Emission (CBEM) reduces the quality of life in Nigeria, Gas Flaring (GAFL) decrease quality of life in Nigeria, and Particulate Matter 2.5 Emission (PMAT) increase quality of life in Nigeria,

The study therefore concluded that Carbon Dioxide Emission (CBEM), and Gas Flaring (GAFL) reduces quality of life in Nigeria while Particulate Matter 2.5 Emission (PMAT) do not decrease the quality of life in Nigeria within the period under review.

Recommendations

- Government should create employment opportunities for the idle youths so as to take their minds off pipeline vandalization
- Government should ensure strict compliance of the law on oil spillage and gas flaring in Nigeria.
- Government should ensure that the Host Community trust fund (HCTF) is judiciously spent on the victims of oil spillage and gas flaring.
- Fines by defaulting companies should be so exorbitant so as to deter them while the gas can be processed and produced into cooking/domestic gas.
- The Federal Government should step up its campaign against pipeline vandals by prosecuting all people caught in this criminal act.

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