

Investigation of the Negative Effects of the Use of Conventional Diesel and Gas Flaring in Egbema Imo, State

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Abstract

Sequel to the need to reduce greenhouse gases emissions as a mitigative measure to climate change this study investigated greenhouse gases reduction rate from the blending of conventional diesel with jatropha curcas oil. The study Negative effect of the use of conventional diesel and gas flaring in Egbema, Imo state were ascertained. Survey Research Method was adopted. Applying the Taro Yammaine formular, the target population was reduced to a sample population of approximately 400 respondents, hence four hundred (400) copies of the questionnaire were administered to the respondents in various households in Egbema using stratified random sampling technique. From the questionnaire survey conducted, it was found that gas flaring has serious adverse effect on vegetation in the area, significant negative effect on the economy of the area due to the rise in air pollution. The study recommended adoption of renewable energy sources for the operation of the oil firms in the study also suggested that blended green diesel is a promising alternative fuel for internal combustion engines as it has proven to be more eco-friendly.

Keywords: *Conventional Diesel Combustion, Gas Flaring Effects, Air Pollution*

1.0 Introduction

1.1 Background to the Study

From the works of earlier scholars like Aderemi (2021), Adewale and Mustapha (2015), Chukwu *et al* (2021) and Elehinafe *et al* (2022), it has been proven beyond doubt that both conventional diesel combustion and gas flaring release pollutants into the atmosphere, contributing to air pollution. Diesel engines emit particulate matter (PM), nitrogen oxides (NO_x), sulfur dioxide (SO₂), carbon monoxide (CO), and volatile organic compounds (VOCs), which can lead to respiratory problems, cardiovascular diseases, and smog formation. Gas flaring releases pollutants such as methane (CH₄), NO_x, SO₂, and VOCs, further worsening air quality. Diesel combustion and gas flaring are sources of greenhouse gas emissions, including carbon dioxide (CO₂), methane, and other gases. These emissions contribute to global warming and climate change by trapping heat in the Earth's atmosphere, leading to temperature rise, sea level rise, changes in weather patterns, and other climate-related impacts.

The release of greenhouse gases from diesel engines and gas flaring contributes to climate change, with long-term consequences for ecosystems, biodiversity, water resources, agriculture, and human settlements. Climate change exacerbates extreme weather events, such as floods, droughts, heatwaves, and storms, posing risks to human health, infrastructure, and natural habitats. Gas flaring can cause environmental degradation in the form of soil and water contamination, vegetation damage, and disruption of wildlife habitats. The release of pollutants from diesel engines can also harm ecosystems, including aquatic ecosystems affected by runoff and air-deposited pollutants (Azeez 2017).

Exposure to diesel exhaust emissions can have adverse health effects on humans, including respiratory illnesses (e.g., asthma, bronchitis), cardiovascular diseases, lung cancer, and premature mortality. Gas flaring emissions, particularly methane and VOCs, can also contribute to health risks, such as respiratory irritation and neurological effects. Gas flaring represents a wasteful practice as it involves the burning of natural gas that could otherwise be captured, processed, and used for energy generation, heating, or industrial purposes. Flaring leads to the loss of valuable energy resources and contributes to energy inefficiency in the oil and gas sector (Barati and Pirozfar, 2019).

Conventional diesel engines and gas flaring are often subject to regulatory scrutiny due to their environmental and health impacts. Community concerns about air quality, pollution, and climate change also drive calls for stricter regulations, emission controls, and sustainable energy alternatives. Addressing these negative effects requires transitioning to cleaner and more sustainable energy sources, improving energy efficiency, adopting emission control technologies, promoting renewable energy deployment, implementing regulatory measures, and raising awareness about the environmental and health risks associated with conventional diesel use and gas flaring (Ede and Edokpa, 2015).

The combustion of biodiesels has been reported to emit lesser pollutants, compared to diesel. Biodiesel is nearly carbon neutral, meaning it contributes almost zero emissions to global warming. Tran-esterification of vegetable oil was conducted as early as 1853, by scientists (Duffy and Patrick, 1853); many years before even the first diesel engine fuel dates back to 1893, when Dr. Rudolf Diesel built the first engine with full intention of running it on vegetative source. Rudolf Diesel's prime model, a single 10 feet iron cylinder with a flywheel at its base, ran on its own power for the first time in Augsburg Germany on August 10th 1893. In remembrance of this event, August 10th has been declared international biodiesel day. Rudolf Diesel displayed his engine at the world fair in Paris, France in 1889 and astonished every one when he ran the patented engine on peanut oil. He received the "grand prix". *In a 1912 speeche said "the use of vegetable oil for engine fuels may seem insignificant today, but such oils may in the course of time become as important as petroleum and coal tar products of the present time* (Divya and Tyagi, 2006). The emission of the greenhouse CO₂ can be reduced when "green" biomass derived transportation fuel such as biodiesel are used (Chmielwski, 2005). The idea that the fossil fuel reserves are limited, together with concerns over security of supply (the oil crisis), initiated the first up rise of interest in biomass and all other renewable energy forms in the 1970s. In the 1980s the concern grew that global warming and the resulting climate change from fossil fuels consumption known as crude oil reserves are estimated to be depletable in less than 50 years at the present rate of consumption. Global attention moved to renewable fuel which is more environmentally friendly.

1.2 Statement of the Problem

The combustion of petroleum diesel is known to increase greenhouse concentrations in the atmosphere, these fuels are likely sources of global warming. Another concern is advocated by the peak oil theory which predicts a rising cost of fossil fuels caused by a severe shortage of petroleum reserves underground during an era of continuous increase in its consumption. According to the peak oil theory, the demand and supply will continue to grow.

Growth in population and industrialization has led to an increase in energy demand in Nigeria. Over the years, fossil fuels have been the major supply of energy, which about 90% being consumed as liquid fuel for transportation and energy generation (Devanesan, 2010). Fossil fuels are non-renewable and have led to global warming and environmental pollution. They cause obvious problems such as oil spills and smog filled air, acid rain, for example, caused particularly by sulphur in fossil fuel which damages buildings and harms trees, aquatic life and insects.

During combustion processes, different pollutants like fly ash, sulphur oxides (SO_2 and SO_3), nitrogen oxides ($\text{NO}_x = \text{NO}_2$ and NO) and volatile organic compounds are emitted. These pollutants are present in the atmosphere in such conditions that they can affect man and his environment. Air and other pollutants not only act directly on the environment but contamination of water and soil leads to their degradation. Wet and dry deposition of inorganic pollutions lead to acidification of environment, a phenomena which affect the health of the people, increase corrosion, and destroy cultivated soil and forests, plant like coniferous trees are not resistant oxides and following longer exposure leaves wither and fall. Many cultivated plants are not resistant to these pollutants, especially in the early periods of vegetation (2005),

Many authors like Nelson (2010), Nawa, Thomson and Bradey (2019), Haziratul (2017) among others tried to buttress the fact that the use of fossil fuel or conventional diesel is damaging environmental quality but there is yet to be a thorough investigation of the nature of the negative effects of this practice in Nigeria particularly in an area like Egbema with numerous industries burning conventional diesel, hence the need for this work.

1.3 Aim and Objectives: The aim of this study is to investigate the negative effects of in Imo State, Nigeria. To achieve this aim; the following objectives were pursued to:

1. To review the challenges in the use of conventional energy sources.
2. To review the general negative effects of gas flaring.
3. To ascertain the negative effects of the use of the conventional diesel in Egbema, Imo State.

2.1 Challenges in the use of Conventional Energy Sources

Loaiciga, (2011) conducted a study on Energy, carbon dioxide emissions, fossil fuels, Energy technology, carbon dioxide, Energy consumption, Gross domestic product, Biofuels, wind power in U.S.A using analysis of energy related data collected from China, India, the United States for period of 2005 – 2035 to gain insight on the evolution of energy intensity, the pattern of carbon-dioxide equivalent (CO_2) emitted per unit of GDP, reductions in the carbon intensity required to achieve CO_2 emissions comparable to the 1990 Kyoto protocol's baseline year, key obstacles to transitioning to a world economy less dependent on fossil fuel. Key findings

revealed the world's total primary energy use is expected to increase by 56% in the period 2005 – 2035, The researcher recommended for 4-fold reduction of emissions of the world's carbon intensity.

Omoruyi and Idiata (2015) carried out a study on the Environmental and cost implication of fossil fuel generators: in New Benin market, Benin city, Nigeria using questionnaires administered to people which shows that there is a prevalent use of fossil fuel generator for electric power supply to buildings in Nigeria. In 2004, the International Energy Agency (IEA) estimated that fossil fuels will account for 85% of the energy market by 2030. Findings shows the associated environmental health and social hazards are major concerns to both the users and their neighbours to include impaired hearing, impairing visibility, deafness, sleeplessness, choking sensation and dizziness. The average cost of running the fossil fuelled generators ranges from N = 6,513 to = N = 32, 500 monthly.

Chmielewski (2005) conducted a study on Environmental Effects of Fossil Fuel combustion in U.S. where he discussed major constituent of fuel to include carbon, hydrogen, oxygen, metal, Sulphur, and Nitrogen compounds. During the combustion process different pollutants like fly ash, sulfuric oxides (SO₂ and SO₃) Nitrogen oxides (NO_x = NO₂ + NO) and volatile organic compounds are emitted findings revealed that gross emission of pollutants is tremendous all over the world. These pollutants are present in the atmosphere in such conditions that they can affect man and his environment. Air pollution caused by particulate matter and other pollutants not only acts directly on the environment but by contamination of water and soil leads to their degradation

Grossman (2016) carried out a study on how the use of fossil fuel threatens kid's health in New York City. He adopted the survey research method using data at point source to a growing need for society to better protect kids. The burning of fossil fuels by vehicles, power plants, factories and even homes spews particles and gases into the air. The people most vulnerable from breathing them tend to be the youngest. The immune system helps defend the body against infections and poisons, such as toxic chemicals. But in infants and children, the immune system has not yet finished developing. This means that the body is not fully protected from impacts such as breathing irritating or toxic pollutants. Not surprisingly, studies have shown that fossil-fuel pollutants, including hydrocarbon compounds, can impair health. They can even affect a child's brain. Findings revealed that fossil-fuel burning contributes to the build-up of carbon-dioxide. It's one of the so-called greenhouses gases. In the atmosphere, this CO₂ can trap the sun's heat, leading to global warming. A number of recent studies have linked hotter air temperatures to a warming also is boosting the spread of some infectious diseases. These range from malaria to Chikungunya. Fossil fuel emissions contribute to both illness and climate change. Warmer temperatures help transform fossil fuel pollution into Smoggy Ozone. Inhaling Ozone can irritate the lungs; it can even cause trouble breathing, especially for children with asthma. Earth's rising temperatures have also been triggering an increase in extreme weather. These droughts, intense storms, flooding and wildfires can pose their own serious health impacts. They can damage homes, for instance, they can uproot families. Sometimes their impacts lead to food shortage. The Researcher recommended for the need of getting Energy from sources other than fossil-fuel burning which will provide huge benefits to health and the environment. The combustion of petroleum diesel is known to increase greenhouse concentrations in the atmosphere, these fuels are likely sources of global warming.

Growth in population and industrialization has led to an increase in energy demand in Nigeria. Over the years, fossil fuels have been the major supply of energy, which about 90% being consumed as liquid fuel for transportation and energy generation (devanesan, 2010). Fossil fuels are non-renewable and have led to global warming and environmental pollution. They cause obvious problems such as oil spills and smog filled air, acid rain, for example, caused particularly by sulphur in fossil fuel which damages buildings and harms trees, aquatic life and insects.

During combustion processes, different pollutants like fly ash, sulphur oxides (SO_2 and SO_3), nitrogen oxides ($NO_x = NO_2$ and NO) and volatile organic compounds are emitted. These pollutants are present in the atmosphere in such conditions that they can affect man and his environment. Air and other pollutants not only act directly on the environment but contamination of water and soil leads to their degradation. Wet and dry deposition of inorganic pollutants lead to acidification of environment, a phenomena which affect the health of the people, increase corrosion, and destroy cultivated soil and forests, plant like coniferous trees are not resistant oxides and following longer exposure leaves wither and fall. Many cultivated plants are not resistant to these pollutants, especially in the early periods of vegetation (2005),

3.1 Study area

Imo is one of the 36 states of Nigeria and is in the southeast region of Nigeria. Owerri is its capital and among the largest towns in the state. Other notable towns are Orlu, Obowo, Oguta, Mbaise, Okigwe, Egbema, amongst others. It is located in the south eastern region of Nigeria; it occupies the area between the lower River Niger and the upper and middle Imo River. Nickname(s) eastern heartland. Coordinates $5^{\circ}29'N$ $7^{\circ}21'E$, created 3 february 1976. The state covers an area land mass $065,530 km^2$ ($2.140 sqm$) and ranked 13th out of the states in Nigeria in terms of land area (<http://sllen.m.wikipedia.org>).

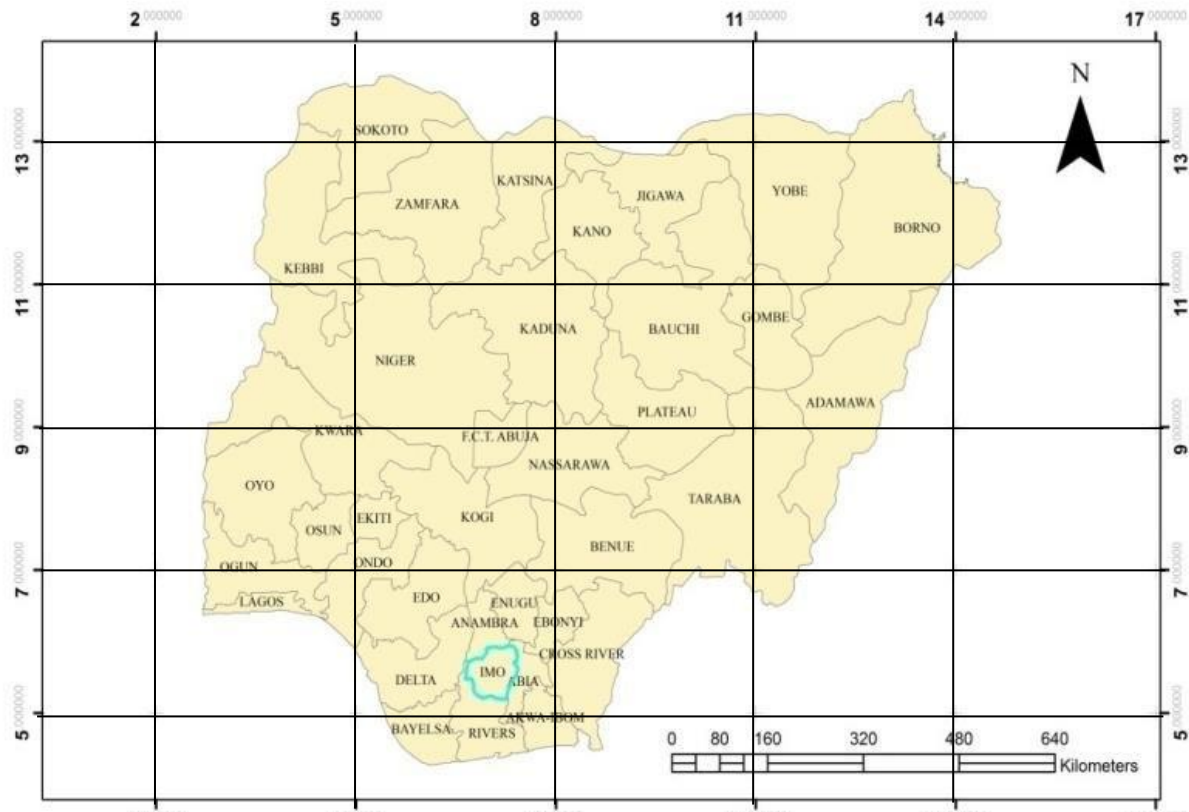


Figure 1: Nigeria Showing Imo State.

3.2 Study location and climate

Ohaji-Egbema is an oil-rich Local Government in Imo State, Nigeria. Its headquarters is Mmahu-Egbema. Ohaji/Egbema local government area as presently constituted was created by the Gen. Ibrahim B. Babangida's administration by the August 27, 1991 presidential proclamation, it was created out of the former Ohaji/Egbema/Oguta L.G.A.



Fig 3.2 Map Of Imo State Showing Egbema

Ohaji/Egbema geographical coordinates: latitude: 5.30583, longitude: 6.94556 5° 18' 21" north, 6° 56' 44" east:ohaji/ area: 89,000 hectares 890.00 km² (343.63 sq mi)

3.2.1 Economic activities: The occupation of the people of this area is predominantly farming and fishing. Their soil is endowed with abundant mineral resources like crude oil and gas. They are the highest oil producing community in the country with 21-23% of the nation's gas reserves.

3.2.2 Population growth: The population of projected from 2006 population census at an annual population growth rate of 3.0% is 251,900 (net.Www .mindat. Org s 2020).

3.3 General Overview

The study area in Imo State, was selected because it is an oil rich area and has a lot of industries with combustion engines utilizing conventional diesel and can therefore be used for a questionnaire survey site on issues pertaining the effects of use of conventional diesel in diesel engines. Imo is one of the 36 states of Nigeria and is in the southeast region of Nigeria. Owerri is its capital and among the largest towns in the state. Other notable towns are Orlu, Obowo, Oguta, Mbaise, Okigwe, Egbema, amongst others. It is located in the south eastern region of Nigeria; it occupies the area between the lower river Niger and the upper and middle Imo river. Nickname(s) eastern heartland. Coordinates $5^{\circ}29'N$ $7^{\circ}21'E$, created 3 february 1976. The state covers an area land mass $065,530\text{km}^3$ (2.140sqm) and ranked 13th out of the states in Nigeria in terms of land area (<http://sllen.m.wikipedia.org>).

3.4 Research design

Considering the aim and objectives of this study, the survey research design was adopted. The survey design involved the sampling of the inhabitants of in Imo state to ascertain the negative effect of the use of conventional diesel in the area.

3.5 Target Population

The target population of this study is the total population of the inhabitants of which is 251,900, from which the sample size for the questionnaire survey was draw.

3.6 Sample Size and Sampling Techniques

The sample size for the questionnaire survey will be drawn from the target population of using the taro yammaine formula that is given by where n is the target population and e is 5% level of significance.

$$SS = \frac{N}{1+N(e)^2}$$

Thus from Taro Yamaine's formula, the sample population for the questionnaire survey is $251,900 / 1 + 251,900 (0.05)^2 = 251,900 / 630.75$

$= 399.366$. Therefore approximately 400 copies of the questionnaire were administered.

3.7 Instruments for data collection

Questionnaire: A well-structured questionnaire was designed and used to source information on the negative effects of the use of conventional diesel. The questionnaires were of two sections, section A and section B While section a addressed issues bothering on the bio-data of the respondents, section b was strictly deal on the negative effects of the use of conventional diesel in the study area (Egbema).

4.0 Presentation of Findings and Results

To ascertain the negative effects of the use of the conventional diesel in , Imo State. The responses are contained in tables 3 to 6.

Information contained in tables 4.1 to 4.5 are structured on a 5–point likert scale; strongly disagree (sd=1), disagree (d=2), not sure (ns=3), agree (a=4) and strongly agree (sa=5). From the likert scales, a mean cut-off point was calculated as follows:

$$\bar{x} = \frac{1+2+3+4+5}{5} = \frac{15}{5} = 3.0$$

From the cut-off point, any issue whose mean response is 3.0 is regarded as agree while those with mean responses less than 3.0 are regarded as disagree.

Table 4.1: Environmental Emissions of Greenhouse Gases in Egbema

S/n	Issue raised	Sd	D	Ns	A	Sa	Mean	Remark
1	Greenhouse gases (GHGs) emissions are responsible for acid rains which impact aquatic life in .	4	55	2	240	98	3.93	Agree
2	GHGs emissions destabilize the sustainability of the ozone layer making the environment more harmful.	16	47	2	203	131	3.97	Agree
3	GHGs emissions are responsible for global warming and climate change.	30	59	2	174	134	3.81	Agree

Source: researcher’s field survey, 2023

Table 4.2: Health Effects of Emissions Greenhouse Gases in Egbema

S/n	Issue raised	Sd	D	Ns	A	Sa	Mean	Remark
1	Black carbon from gas flaring can cause breathing and other respiratory diseases.	12	33	1	263	90	3.97	Agree
2	People who live nearby are at the risk of brain tumors.	4	79	24	155	137	3.86	Agree
3	Gas flaring puts benzene into the air which causes headaches.	36	68	5	172	118	3.67	Agree

Source: researcher's field survey, 2023

Table 4.3: Socio-Economic Effects of Emissions of Greenhouse Gases in Egbema

1	There is very high cost of cleaning the environment after gas flaring	4	21	2	259	113	4.14	Agree
2	The gas that is flared can also be liquefied and used to generate revenue	4	36	3	180	176	4.22	Agree
3	The economy of the area is negatively affected due to air pollution.	4	49	25	166	155	4.05	Agree

Source: researcher's field survey, 2023

Table 4.4: Possible Remedial Measures of Effects of Emissions of Greenhouse Gases in Egbema.

S/n	Issue raised	Sd	D	Ns	A	Sa	Mean	Remark
1	The adoption of renewable energy sources for the operation of the oil firms in	18	27	1	230	123	4.04	Agree
2	Imports of petroleum-based fuel will be reduced if all players in the energy sector collaborate to promote the production of biodiesel from a variety of sustainable feedstock	10	76	44	144	125	3.75	Agree
3	The combustion features and the engine power output of biodiesel were comparable to that of fossil fuel.	50	80	35	137	97	3.38	Agree

Source: researcher's field survey, 2023

Discussion of results and findings:

From table 4.1 and following the likert scale cutoff point, we can conclude as follows on the environmental emission of greenhouse gases in Egbema:

- a. Greenhouse gases (GHGs) emissions are responsible for acid rains which impact aquatic life in Egbema,
- b. GHGs emissions destabilize the sustainability of the ozone layer making the environment more harmful,
- c. GHGs emissions are responsible for global warming and climate change,

Table 4.2 has information on the health effects of emission of greenhouse gases in , it can be seen that all the issues raised have their mean cut-off points greater than 3.0. Therefore, the health effects are:

- a. Black carbon from gas flaring can cause breathing and other respiratory diseases,
- a. People who live nearby are at the risk of brain tumors.

As contained in table 4.3 shows that all the issues raised has the mean cut-off point greater than 3.0, implying that the respondents agreed that the issues are true. Therefore, the socio-economic effects are:

- a. There is very high cost of cleaning the environment after gas flaring,
- b. The gas that is flared can also be liquefied and used to generate revenue,

Table 4.4 has the views of the respondents on possible remedial measures of effects of emissions of greenhouse gases in Egbema. The following are the possible remedial measure as opined by the respondents:

1. The adoption of renewable energy sources for the operation of the oil firms in ,
2. Imports of petroleum-based fuel will be reduced if all players in the energy sector collaborate to promote the production of biodiesel from a variety of sustainable feedstock,

CONCLUSION:

From the study, the following were concluded:

1. Emissions of GHGs in through gas flaring has serious adverse effects on vegetation in the area.
2. There is frequent cases of skin irritations and skin diseases,
3. Biofuels are considered among the most promising fuel because of the availability of their feedstock and less toxic emission.
4. Biofuels can easily be obtained from the locally produced feedstock, but this may affect food security.
5. People who live nearby are at the risk of brain tumors.

RECOMMEDATION:

The study recommended as follows:

1. That biodiesel fuel should be adopted as a substitute for fossil-based fuel to mitigate poisonous gas emission rate.
2. Blended green diesel is a clean fuel for the environment and should be adopted.
3. The gas that flared can also be liquefied and used to generate revenue.

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