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THE IMPACT OF NON-RENEWABLE ENERGY AND AGRICULTURE ON ENVIRONMENTAL SUSTAINABILITY IN NIGERIA

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Abstract: This research looks at the impact of non-renewable energy and agriculture on environmental sustainability in Nigeria. The study utilized survey methodology to collect data from the population of Rivers State. The total population of the five state was estimated at 5,198,716 as of 2006 census. With the implementation of Taro Yamane formulae, the population size decreased to 400 people. Two local government areas were selected from each of the three senatorial district that made up the state making it a total of 6 LGA's. Out of the 400 questionnaires sent out, a total of 306 respondents from the 6 LGA's returned. With a mean criterion of 3.0, the statistical tools of the Statistical Package for the Social Sciences (SPSS) were used to analyse the study's research questions. Findings from the study show that pollution of farmland, logging/lumbering, shortage of fresh water and farmlands, loss of biodiversity, land degradation, oil spill among others are all the ways by which non-renewable energy hinders agriculture and environmental sustainability. The study also shows that loss of soil nutrient and groundwater nitrate, destruction of forest reserve and environment etc. are some of the ways agriculture limit environmental sustainability in Rivers State, Nigeria. The study gave some recommendations and concluded that public education/enlightenment and effective policy that encourage and promote renewable energy consumption and modern agricultural practice need to be put in place in Rivers State, Nigeria in other to reduce dependency on non-renewable energy in the state.
Keywords: Agriculture; Environmental sustainability; Nigeria; Non-renewable energy

1 INTRODUCTION

Believe it or not, plants and animals have been used since millions of years ago to light our candles, fuel our cars, farm machinery and heat our homes. These are called fossil fuels, and are one of the types of non-renewable energy. Non-renewable energy sources have been used by humans for centuries and are essential to understanding how our modern world works. An energy source is non-renewable if, when used, the total amount of that source decreases and cannot be replaced quickly (i.e. in our lifetime) or is exhausted by the human body (the amount of reserve all). Large sources of energy cause air pollution, due to the use of oil and gas, and many non-renewable sources. These factors have negative consequences for the health of the people and the surrounding environment [1]. Air pollutants have the potential to enter ecosystems and natural water bodies, harming marine life and contaminating clean water [2]. Economic growth in developed and developing countries is closely related to air pollution, because different economic activities in different sectors contribute to this problem [3]. In Rivers State, Nigeria's non-renewable electricity supply is essential to drive business growth by contributing to income generation, growth, job creation and investment, despite the threat that related to agriculture and environmental health. The agricultural sector also plays an important role in promoting a country's economic development and progress. Emissions from activities related to cultivation including burning hedges, utilizing nutrients, using substances forest destruction, insufficient hunting, alongside converting grasslands towards cultivable land during cultivation, contribute to the rise in GHG emissions [4]. Around 20%-24% of a significant portion of global greenhouse gas emissions come from AFOLU, which refers to farming, forestry, and additional activities involving land [5]. Throughout the final decade of the last century, there came to be a notable rise in global agricultural production, paralleling the increase in population. The rapid growth of the global population delivers a substantial danger to the sustainability of agriculture and the health of the planet is of utmost importance, as it results in a significant increase in the world's need for nutrition [6]. Balasundram et al, [7] noted that the agriculture sector was officially recognized just like a major source of the release of greenhouse gases since it is inefficient farming methods used to boost productivity and ensure food security.

According to Kabange et al, [8] utilizing fossil fuel-powered farm machinery, implementing irrigation systems, practicing confined animal rearing, and applying nitrogen-rich nutrients contribute to emissions in the agriculture sector. By implementing measures such as preventing deforestation, promoting woodland regeneration, improving plant and animal care, and investing in green energy production, the agricultural sector could potentially achieve a 20% reduction in total emissions by 2050. According to Chen, R, & Kong, Y. [9] Environmental sustainability problem seems a prominent subject of study for researchers in the last century, as a result of the increase in the emission of greenhouse

gases (GHGs), particularly CO2. As the population of Rivers State continue to increase and becomes more affluent, it leads to drastic increase in the use of non-renewable energy source thereby increasing the pressure on agriculture to deliver sustainable food production, distribution, and consumption that simultaneously foster human wellbeing [10]. As a result, there has been a renewed interest from policy makers, development agencies, community organizations and the private sector to examine the role of food and agricultural markets in promoting growth. of the environment that benefits people and the world [11]. The agricultural sector is undergoing major changes and faces many environmental and social challenges. The impact of increased energy uses in Rivers State, especially non-renewable energy each year due to increased demand, has had a major impact on agriculture and environmental health. The increased use of non-renewable energy in Rivers State poses challenges to politics, agriculture, sustainable development, environmental sustainability and food security not only for Rivers State but for All Nigeria. In the present day, research in Nigeria have confirmed the persistent increase in the use of non-renewable energy (fossil fuel) have bring about decrease in the rate of food production and environmental pollution resulting to social disorder. The focus now in Rivers State and Nigeria as a whole is how to increase non-renewable energy (fossil fuel) production and agricultural productivity with minimal attention given to environmental sustainability in order to carter for the timing population in the state which in return affect the environment and has become a problem in the state. Therefore, the research problem focusses on the impact of non-renewable energy on environmental sustainability in Rivers State, Nigeria; the impact of agriculture on environmental sustainability in Rivers State, Nigeria and finally, the impact of non-renewable energy on agriculture in Rivers State, Nigeria. Base on this background the researchers intends to carry out this study in other to provide solutions these problem identify.

2 THEORETICAL LITERATURE

2.1 Energy Rebound Theory

Energy rebound theory posits an argument infrequently used by critics of energy efficiency policies. The policies of energy efficiency lead to an increase in the consumption of energy in an economy, that is efficiency policy raises energy use to increase to a higher level compared to the initial level because there is a reduction in energy use and emission is less than the expected reduction caused by an energy efficiency improvement due to induced behaviour adjustment of relevant economic agent [12] there is tendencies that there would be increase in energy consumption as a result of a reduction in the price of energy which will in turn lead to economic growth and development and also lead to more emission CO2. The more efficiently energy generation and consumption, the more economic growth and development but when this negates the efficiency use gain and thus raise emission level, it increases the level of environmental degradation which reduces agricultural practice.

2.2 Environment Kuznet Curve

The Environmental Kuznets Curve (EKC) is a horizontal relationship between various indicators of environmental degradation and per capita income. Since its introduction a quarter of a century ago, the EKC has been the leading approach among economists for modeling pollutant concentrations and cumulative emissions. At the beginning of economic growth, pollution emissions increase and environmental quality decreases, but in addition to the level of income per capita (it changes for different indicators) the process reserve, so at high levels of income economic growth occurrence lead to environmental improvement.

According to Panayotou [13], environmental impact or per capita emissions is a U-shaped inverted function of per capita income. If there is no change in the structure of the economy or technology, the net growth in the size of the economy will result in the growth of pollution and other environmental impacts. This is called the scale effect. The conventional wisdom is that economic development and environmental quality are conflicting goals that show the effect of scale. Supporters of the EKC hypothesis claim that at higher levels of development, the structure will change to industries and services related to information, and increase awareness of the environment, implementation of environmental laws, improved technology and higher environmental costs, lead to reductions and declines of environmental degradation. Summarily, the EKC can be explained by the following "proximities": An increase in the scale of production requires an increase in output. The pollution intensity of different industries varies, and the structure of production often changes during economic development. Changes in the composition of inputs involve the substitution of less environmentally harmful inputs rather than more harmful inputs, and vice versa. The last two cases are called technological effects due to environmental constraints or creative processes. In addition, the improvement of the state of technology shows changes in the efficiency of production both for the use of less, ceteris paribus, of polluting input per unit of production. Specific emission changes in the process result in lower pollutant emissions per unit input. Some recent studies have shown that the increase in GDP and carbon emissions due to energy consumption does not lead to environmental degradation, especially in some developing or emerging economies. In contrast, some researchers have pointed out that many developing countries are reducing their CO2 emissions through reductions and emissions reductions. This discussion was explained in the context of the research process.

2.3 Empirical Literature

Dansofo et al. [14] explored the impact of non-renewable energy consumption and economic growth on carbon emissions in Nigeria using annual data from 1980 to 2022 through the Autoregressive Distributed Lag Model. The findings indicate a long-run relationship between economic growth, non-renewable energy use, and CO2 emissions. Both long-term and short-term ARDL estimates show that economic growth and non-renewable energy consumption significantly increase CO2 emissions. The study suggests implementing regulations and innovative strategies to foster economic growth while using non-renewable energy sources, alongside policies from energy regulatory commissions and environmental agencies, to invest in and promote carbon-reducing technology to mitigate environmental degradation.

Udoinyang, N [10] studied agricultural value chain and environmental degradation in Akwa Ibom State. Using the Taro Yamane formula, a sample size of 400 was determined, and questionnaires were distributed across six local government areas. Analysis via SPSS revealed that agricultural practices impact environmental degradation through climate change, forest and ecosystem destruction, soil nutrient loss, water pollution, damage of inter communal road. The study concludes that an effective public policy design is crucial to reduce the problems of bad agricultural value chain system, sustainable agricultural development and environment free from degradation can be achieve in Akwa Ibom State.

Samuel A. & Christian N. [15] explore whether renewable energy reduces carbon dioxide emissions in 28 Sub-Saharan African countries (1980–2014) using OLS and GMM estimation techniques. Findings indicate both renewable and non-renewable energy contribute to CO2 emissions in the long run, with non-renewable energy having a significant short-term impact. Specifically, a percentage increase in non-renewable energy consumption raises CO2 emissions by 1.07% in the short run and 1.9% in the long run. Economic growth worsens environmental degradation while urbanization diminishes CO2 emissions. Additionally, GDP growth increases emissions by 1.3% in the short run and 1.82% in the long run, with less democratic states more likely to pollute than democratic ones. No significant short-term effect of non-renewable energy was observed in more democratic nations. From these studies, it becomes evident that while significant research exists on energy and the environment globally, including in Nigeria, none specifically focus on Rivers State or the combined impact of non-renewable energy and agriculture on environmental sustainability. To address this gap, this research investigates the impact of both factors on environmental sustainability in Rivers State, Nigeria.

3 METHODOLOGY

The study adopts survey research design to examine the impact of non-renewable energy and agriculture on environmental sustainability in Rivers State, Nigeria. Primary and secondary data were employed in the study. The population for this study consists of all the local government that make up Rivers State. There are twenty-three local governments that make up Rivers State. Its total population was estimated at 5,198,716 as of 2006 census making it one of the largest states in Nigeria. With the use of Taro Yamane the population size was reduce to 400. The research instrument adopt for this study is a self-structured questionnaire titled the impact of non-renewable energy and agriculture on environmental sustainability in Rivers State (N.R.E.A.E.S). It enabled the researchers obtained relevant data for the research. The descriptive statistical tools of: tables, percentages, averages and more were used for data presentation. On the other hand, 5 Linkert scale with the use of Mean and Standard Deviation in Statistical Package for Social Science (SPSS) were used in analysing the three research questions. The research questions were analysed using a mean criterion of 3.0 for the research questions, an aggregate mean below 3.0 means the respondents disagree with the stated research question while an aggregate mean of 3.0 and above means the respondents agree with the stated research questions. The questionnaire was designed to elicit information from the respondents, and to suit the need and purpose of the study. The questionnaire was designed in four (4) sections. The first section looked at demographic data of the respondents such as; gender, age, occupation and academic qualification. The second analyse the impact of non-renewable energy on environmental sustainability in Rivers State Nigeria, the third section analyse the impact of agriculture on environmental sustainability in Rivers State Nigeria, and finally, the forth section analyses research question three which is the impact of non-renewable energy on agriculture in Rivers State, Nigeria. The questionnaire adopted a 5-point Likert scale of Strongly agreed (SA), Agreed (A), Undecided (U), Strongly Disagreed (SD), and Disagreed (D). The instrument is made up of a total of 19 items. Purposive sampling techniques were adopted for the study. For the purpose of clarity, six (6) local government out of the twenty-three (23) Local Government Areas in Rivers State were purposively selected as the sample of this study. The choice of using Purposive sampling techniques in this research work is that it provides non-probability samples which receive selection based on the characteristics which are present within a specific population group and the overall study. It also helps the researcher to identify the extreme perspectives that are present in each population group as well. Base on purposive sampling technique, two local government areas were selected from each of the three (3) senatorial district that made up Rivers State making it a total of six (6) local government areas and they are as follows: Etche; Emohua; Ahoada West; Ogba/Egbema/Ndoni; Eleme and Gokana local government areas of Rivers State.

3.1 Data Presentation

The data was presented based on the research objectives. Primary and secondary data were reviewed and questionnaire was distributed based on senatorial district, local government area, specific demographic characteristics such as age, gender, marital status, occupation and all other demographic variables are calculated using percentages.

Table 1 Socio-Demographic Characteristics of the Participants

Socio-Demographic Characteristics	Frequency	Percentage
Gender		
Male	190	47.5
Female	210	52.5
Total	400	100
Marital Status		
Single	124	31.0
Married	276	69.0
Total	400	100
Age Range		
20-30 years	65	16.25
31-40 years	133	33.25
41 years and above	202	50.50
Total	400	100
Highest Educational Qualification		
FSLC	189	47.25
HND/BSC	145	36.25
MSC/PHD	66	16.50
Total	400	100
Occupation		
Civil servants	47	11.75
Business owners	97	24.25
Farmers	124	31.00
Traders	55	13.75
Private sector workers	44	11.00
Students	33	8.25
Total	400	100

Source: *Authors Compilation, 2024.*

In Table 1 above, it shows the demographic distribution of the respondents. Among the four hundred respondents, an excessive percent is married, accounting for 69.0% of the total. The gender breakdown become observed to be 210 females (52.5% of the total) and 190 males (47.5% of the total). In phrases of age, the maximum respondents had been 41yrs and up, with 202 (50.50%), at the same time as the youngest had been 20yrs-30yrs which accounted to 65 (16.25%). Similarly, whilst requested approximately their educational background, people with a FSLC had the maximum respondents, at the same time as people with MSC/PhD had the fewest and finally, the farmers have the highest number 124 (31.00%) in terms of occupation.

Table 2 Senatorial Distributions of the Questionnaires

Senatorial District	No. of L.G.A	Names of L.G.A	Names of Selected L.G.A	No. of questionnaire distributed	No. of questionnaire returned
Central Senatorial District	8	Emohua Ikwerre Etche Omuma Port Harcourt Obio/Akpor Ogu/Bolo Okirika	Emohua Etche	66 66	46 53
West Senatorial District	8	Bonny Degema Asari-Toru Akuku Toro Ogba/Egbema/Ndoni Ahoada East Ahoada West Abua/Odual	Ahoada West Ogba/Egbema/Ndoni	66 66	49 51
South East Senatorial District	7	Andoni Opobo/Nkoro Gokana Khana Eleme Oyigbo Tai	Eleme Gokana	70 66	57 50

Source: *Author's Compilation (2024)*

From table 2 above, it can be seen that Eleme LGA was given the highest number of questionnaire because of refinery company located in the area that produce non-renewable source of energy in the state. Emohua has the lowest number of questionnaire returned (46) while Eleme has the highest (57) number of questionnaire returned.

3.2 Data Analysis

The data analysis was based on the research objectives. Primary and secondary data were reviewed. Questionnaire was analyse using mean and standard deviation for descriptive statistics. For reliability coefficient of the instrument, the instrument was administered to 20 persons and afterwards Cronbach alpha method was used to determine the reliability coefficient of the instrument using SPSS software in secondary analysis to draw conclusion.

3.2.1 Research question one

What is the impact of non-renewable energy on environmental sustainability in Rivers State?

Table 3 Respondents Perceptions on the Impact of Non-Renewable Energy on Environmental Sustainability in Rivers State

S/N	Factors	Mean	Standard Deviation	Decision
1	Various water pollution is being experienced in the Rivers State as a result of the production of non-renewable energy as this brings about shortage of freshwater thereby hindering environmental sustainability in the state.	3.9	3.7	**Agreed**
2	Non-renewable energy production affects environmental sustainability as a result of loss of biodiversity in Rivers State.	3.2	3.1	**Agreed**
3	The establishment of industries such as refinery, petrochemical/indorama, etc. that produces non-renewable energy source led to threat of environmental sustainability in Rivers State	3.2	3.1	**Agreed**
4	Non-renewable energy exploitation in Rivers State brings about land degradation in form of land pollution in the state as this affect the state environmental sustainability.	3.6	3.5	**Agreed**
5	Fossil fuel which is the main energy source for transportation releases huge quantities of poisonous gases such as carbon monoxide, nitrogen oxides, and hydrocarbon thereby disrupting sustainable environment of the state.	3.6	4.1	**Agreed**
6	Increase in the demand of non-renewable source of energy such as fossil fuel brings about increase in greenhouse emission which is a major threat to environmental sustainability in Rivers State.	3.6	3.4	**Agreed**
7	Non-renewable energy production leads to increase in water and land pollution which in turn reduce the level of environmental sustainability in Rivers State.	4.3	3.9	**Agreed**
8	The use of fossil fuel in powering vehicles, generators, motor vehicle has led to both noise and air pollution in Rivers State and this disturb it environmental sustainability.	4.2	3.7	**Agreed**
9	Local means of non-renewable energy source brings about deforestation that led to the loss of valuable plant and animal habitat in Rivers State.	3.9	3.5	**Agreed**
10	Most of the trees that provide shelter, oxygen to the natural environment is being cut down and used as a source of energy thereby destroying the environmental sustainability in Rivers State.	4.4	4.1	**Agreed**
11	Non-renewable energy led to various oil spill in Rivers State which has affected it sustainable environment.	3.8	3.6	**Agreed**
	Aggregate mean	**3.8**	**3.3**	**Agreed**

Source: *Authors Field Work, 2024*

Using data from table 3, items 1–11 aimed to discuss the impact of non-renewable energy on environmental sustainability in Rivers State, Nigeria. The items' means are all higher than the mean criteria of 3.0, as seen in the table above. Also, the standard deviation is 3.3 and the overall mean is 3.8 based on all the responses.

3.2.2 Research question two

What is the impact of agriculture on environmental sustainability in Rivers State?

Table 4 Respondents Perceptions on the Impact of Agriculture on Environmental Sustainability in Rivers State

S/N	Factors	Mean	Standard Deviation	Decision
1	Increase in agricultural practice brings about climate changes as the natural environment is been interrupted by those who carried out such practice.	3.2	3.2	**Agreed**
2	Forest reserve are being destroy to provide more land for farming/agriculture in order to meet up the demand for agricultural product thereby hindering environmental sustainability in the State.	4.1	3.8	**Agreed**
3	Bush animals and the entire ecosystem is being jeopardize in Rivers State for the success of agriculture as this serve as a bottle neck to sustainable environment.	3.9	3.6	**Agreed**
4	The natural soil nutrient is being destroy and waters are being polluted by the activities of those who engage in agriculture either manually or by machines through	4.3	3.8	**Agreed**

	the use of chemical and other substance that affect environmental sustainability in the state.			
5	Most of the bye product of agriculture that are not recycle in Rivers State end up becoming waste product thereby increasing the rate/level of waste in the state which serve as a threat to the state environmental sustainability.	3.5	3.8	**Agreed**
6	Increase in agricultural practice led about destruction of inter communal roads and this serve as another hindrance to environmental sustainability in the State.	4.0	3.7	**Agreed**
7	Emissions of ammonia from cattle waste leads to environmental pollution and sustainability threat.	3.8	3.5	**Agreed**
8	The application of nitrogen by farmers brings about loss of nitrate to groundwater and this hinders environmental sustainability in the state.	3.4	3.2	**Agreed**
9	The use of pesticide and fertilizer in agriculture lead to both air and land pollution thereby reducing the level of environmental sustainability in Rivers State.	4.1	3.7	**Agreed**
	Aggregate mean	**3.8**	**3.6**	**Agreed**

Source: *Authors Field Work, 2024*

Again from table 4's items1–9 attempted to handle the impact of agriculture on environmental sustainability in Rivers State, Nigeria. The items' means are all higher than the mean criteria of 3.0, as seen in the table above. In addition, a standard deviation of 3.6 was obtained from the total number of responses, which yielded an aggregate mean of 3.8.

3.2.3 Research question three

What is the impact of non-renewable energy on agriculture in Rivers State?

Table 5 Respondents Perceptions on the Impact of Non-Renewable Energy on Agriculture in Rivers State

S/N	Factors	Mean	Standard Deviation	Decision
1	Non-renewable energy (oil) production in Rivers State pollutes agricultural lands in the state.	3.5	3.5	**Agreed**
2	It causes climate change which affect farming season in Rivers State as a result of greenhouse emission enacted from oil production.	3.8	3.5	**Agreed**
3	Fossil fuel production brings about acid rain which damage agricultural crops planted on farm land as a result of climate change.	4.0	3.6	**Agreed**
4	Water pollution thereby bringing about shortage of water available for farming. Shortage of farmland for agriculture as a result of oil spill.	4.2	3.9	**Agreed**
5	Raising cost of agricultural farm product in the state as a result of inadequate land	3.8	3.6	**Agreed**
6	available for farming since most farm lands are polluted with oil.	3.9	3.8	**Agreed**
7	Local non-renewable energy production (bunkery) led to displacement of animals. Oil exploitation brings about degradation of agricultural farmland.	3.4	3.2	**Agreed**
8	Local method of non-renewable energy production (oil) brings about	3.2	3.1	**Agreed**
9	logging/lumbering.	4.0	3.7	**Agreed**
	Aggregate mean	**3.8**	**3.5**	**Agreed**

Source: *Authors Field Work, 2024*

Table5's items1–9 focuses on the impact of non-renewable energy on agriculture in Rivers State, Nigeria. The items' means are all higher than the mean criteria of 3.0, as seen in the table above. In addition, a standard deviation of 3.5 was obtained from the total number of responses, which yielded an aggregate mean of 3.8.

4 DISCUSSION OF FINDINGS

Items 1 through 11 in Table 3 aimed to address the impact of non-renewable energy on environmental sustainability in Rivers State, Nigeria. As the accompanying table illustrates, all of the respondents anonymously agreed that non-renewable energy brings about shortage of fresh water, loss of biodiversity, exploitation that led to land degradation, greenhouse emission, water pollution, noise and air pollution, loss of plant and habitat, oil spill, etc. which is in line with findings of Dansofo et al. [14], and Samuel A. & Christian N. [14] that non-renewable energy brings about environmental degradation such as CO2 emission (greenhouse emission) etc. and this obstruct environmental sustainability. Also in table 4, 1-9 which address the issue of the impact of agriculture on environmental sustainability in Rivers State, Nigeria. The findings show that agriculture has some negative impact on environmental sustainability such as: climate change, destruction of forest reserve, increase in waste, destruction of inter-communal roads, loss of soil nutrient and groundwater nitrate which is in line with the findings of Udoinyang Nathan [10] that agricultural practice led to climate change, destruction of forest reserve, soil nutrient, and communal road and these serve as a bottle neck to environmental sustainability. Again, the findings from item 1-9 in table 5 posit that pollution of agricultural farmlands, climate change, acid rain, water pollution, shortage of farmland, increase in the cost of agricultural farm product, displacement of animal, farmland degradation, logging/lumbering etc. are all the impact of non-renewable energy on agriculture which is in line with the findings of Dansofo et al. [14], Udoinyang N. [10] and Samuel A. & Christian N. [15].

5 CONCLUSION AND RECOMMENDATIONS

This paper was able to show the impact of non-renewable energy on environmental sustainability, agriculture and also the impact of agriculture on environmental sustainability. From the findings of this paper, it shows that non-renewable energy production has some negative effect on environment and agriculture which hinders environmental sustainability and pollution of agricultural farmlands which led to shortage of agricultural product in Rivers State, Nigeria. Public education/enlightenment and effective policy that encourage and promote renewable energy consumption and modern agricultural practice need to be put in place in Rivers State, Nigeria in other to reduce dependency on non-renewable energy in the state. The study recommended that adequate regulations, education and innovative ways in fostering economic growth that promote environmental sustainability through renewable energy consumption sources and modern agricultural practice should be implemented alongside policies from energy regulatory commission and environmental protection agencies, to explore avenues to invest in, and promote, carbon-reducing technology in energy and agricultural production processes to mitigate against the effects and degradation of the environment.

COMPETING INTERESTS

The authors have no relevant financial or non-financial interests to disclose.

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