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Research Article

Renewable Energy and Sustainable Economic Development in Nigeria: A Case Study of Rivers State (2000 to 2022)

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Abstract

Using the years 2000 to 2022, this research looks at renewable energy and sustainable economic growth in the Nigerian state of Rivers. This study utilized a survey methodology to collect data from the whole population of Rivers state. A total of 318 people from each of the three senatorial districts filled out the survey, and the researchers used the Taro Yamane formula to determine that a sample size of 400 was appropriate. With a mean criteria of 3.0, the statistical tools of the Statistical Package for the Social Sciences (SPSS) were used to analyze the study's research topics. Reviewing the effects of renewable energy on long-term economic growth in Rivers State, we find that it helps with energy efficiency, keeps socioeconomic development going, lowers emissions of greenhouse gases, air pollution, and climate change, and raises living standards. Lack of renewable energy policy implementation, insufficient investor attraction mechanisms, insufficient technology, insufficient renewable energy developers, insufficient credit facilities accessible to renewable energy developers, and low renewable energy awareness are all mentioned as obstacles to the state of Rivers, Nigeria's renewable energy sector in the study. Sustainable economic development can be achieved through the use of renewable energy, according to the study. The researchers urged the government and policymakers in Rivers State, Nigeria, to train more renewable energy developers, establish credit facilities and an enabling environment for the exploitation of renewable energy, allocate funds, and make renewable energy policy.

Keywords: Energy, renewable energy, economic development, sustainable economic development and sustainable development.

Introduction

The country's energy industry is one of its biggest problems. As one would expect from an oil-rich nation, almost all of Nigeria's energy consumption is fuelled by fossil fuels, namely oil, coal, and natural gas. Overreliance on fossil fuels is one reason the Nigerian energy industry is so susceptible to shocks, according to Akuru and Okoro [1]. They maintain that the present energy administration's incompetence and poor policymaking are to blame for the worsening situation: The energy economy in Nigeria is particularly susceptible to the effects of climate change, poor governance, and pervasive poverty, all of which contribute to the system's lack of resilience. In many countries throughout the globe, energy is crucial to the advancement of society, economy, and sustainability. Future economic progress of a nation is guaranteed by inexpensive, accessible, and environmentally friendly energy sources that do not disrupt service. Energy is interconnected with public health, climate change, and security [2]. But in most nations, the amount of energy used per capita is proportional to the level of living. A combination of factors, including rising living standards and population, has led to a global energy crisis in recent years Rai, [3]. Developing nations cannot attain the Millennium Development Goals—which include ending extreme poverty, providing primary education to all, maintaining environmental stability, and increasing agricultural productivity—unless they have access to better and more reliable energy (MDGB), [4]. The phrase "Sustainable Development" was popularised in the 1987 report "Our Common Future" by the World Commission

on Environment and Development (WCED) [5]. One definition proposed by the Commission for Sustainable Development was "the development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (WCED, 1987). Concerns over long-term economic viability have arisen in response to the recent upsurge in interest in sustainable development throughout the world. As a result, sustainable energy has emerged as a potential solution to the energy demand issues faced by several customers around the globe Hvelplund, [6]. Improvements in energy production efficiency, reductions in energy consumption on the demand side, and the substitution of renewable energy sources for fossil fuels are all part of the sustainable energy development strategy. Commercial, agricultural, and industrial productivity levels are inversely proportional to their energy consumption, which in turn dictates a country's degree of development. Everyday life relies on energy sources including biomass, coal, petroleum, natural gas, and nuclear power. An essential source of energy for every part of the economy, electricity, is generated by the combustion of fossil fuels, which account for over 80% of the world's primary energy consumption. "Access to energy is fundamental to improve the quality of life and is a key imperative for economic development," said the World Economic Forum's Energy Poverty Action Initiative ("IEA,") [7]. Still, the majority of developing nations suffer from energy poverty, and about 1.6 billion people don't have access to power, as reported by the IEA in 2007. An enormous problem has emerged on the African continent: the lack of access to clean, renewable energy. This is a dilemma for the continent's social, political, and economic growth. Despite having the most people of any country in the world (over 200 million) and a GDP of $522 billion [8], Nigeria—also known as "the giant of Africa"—suffers from energy poverty as a result of its underinvestment in renewable energy. In rural regions, where fossil fuels and electricity are scarce, about half of Nigeria's population resides [8, 9]. Because the national electrical grid expansion does not include the whole country, the majority of communities remain without access to electricity. Because of the power outage, individuals have resorted to using whatever fossil fuel they could find, such as petrol or diesel for generators, or kerosene or fuel wood for stoves. On top of that, they have to deal with terrible roads to get the fossil fuel, and there's always a large queue at the petrol station when they want to fill up. Although there has been a plethora of studies on Nigeria's renewable energy resources, remarkably little has been published on the topic of how long these resources will last. To address the issues associated with non-renewable energy sources, several indigenous scholars in Nigeria have investigated renewable energy resources and their potential. The feasibility of a biogas program in Nigeria was evaluated by Akinbami et al. [10], who also determined the feedstock substrate. Assuming a daily production of 227,500 metric tonnes of fresh animal waste and a gas generation rate of 0.03 cubic meters per kilogram of waste, the authors calculate that 6.8 million cubic meters of biogas may be produced in Nigeria. Opeh and Okezie [11] investigated potential applications of biogas in Nigerian cities and rural regions for power generation and home cooking gas production. Biogas energy for cooking, produced from cow dung, offers great economic potential in Nigeria, according to a study by Adeoti et al. [3]. Potential hydropower sites for Nigeria's rural electrification project were surveyed and analyzed by Adejumobi et al. [2] using hydrological data. Theoretical electrical output ranging from 5.13 KW to 5,000 KW from identified small hydropower (SHP) sources was sufficient to meet the needs of an ordinary rural community in Nigeria, according to the authors. According to Akinbami's [14] assessment, Nigeria's hydroelectric power potential is about 8,824 MW, with the ability to produce over 36,000 GWh of energy. Based on their evaluation of SHP development in Nigeria, Ohunakin et al. [15] concluded that the government's efforts to diversify Nigeria's energy sources have been insufficient, as there are still obstacles to SHP development in the nation. Solar energy is an area that has attracted many indigenous scholars. Chineke and Igwiro [16] state that Nigeria receives a substantial quantity of solar radiation, with a daily average of 5.25 kWh/m^2/day. This radiation ranges throughout the country, from 7 kWh/m2/day in the north to 3.5 KWh/m^2/day in the south. According to Okoro and Madueme [17], Nigeria receives around 2,100 × 10^2 kWh of energy per year from the sun, with an incidence of 2,300 kWh/m². The possibilities for producing electricity in Nigeria by means of solar energy were laid forth by Oji et al. [18]. Nevertheless, Shehu [19] surveyed solar sellers and residents in Northern Nigeria, and the results showed that many are open to transitioning to solar power in exchange for financial incentives. Adewale & David [4] conducted a research on wind energy in Nigeria. They looked at data from 30 sites to determine wind speeds (ranging from 1.5 to 4.1 m/s) and power flux densities (5.7 to 22.5 w/m^2). The wind energy potential in Nigeria was detailed by Felix et al. [21], who also laid out the requirements for hooking up the wind generator to the grid. Side effects like oil pollution and gas flaring have persisted in irreparably harming agricultural land and marine

habitat, adding to the already substantial problems of energy availability and security, which are exacerbated by ineffective and bad environmental governance. Roughly eighty-five percent of government coffers are filled by oil sales, which contribute around twenty percent to GDP. Despite oil's importance to Nigeria's economy, the country's citizens nevertheless suffer from widespread energy poverty. Sixty percent of Nigerians, or 85 million people, do not have access to reliable power. Fewer than 20% of Nigerians in rural regions have access to power and even fewer of those who do utilize non-renewable energy sources. Overall, people use about 100 kWh of power each year, which is much lower than the national averages of South Africa (4,500 kWh), Brazil (1934 kWh), and China (1,379 kWh). The government of Nigeria has initiated initiatives to boost the capability of the power supply sector. Power output from fossil fuels should increase by a factor of two as a result of this. Renewable energy is getting some attention from the government, although it still only accounts for a fraction of their energy investment budget. Spending on Nigeria's power grid's non-renewable energy sources is comparable to spending on education in terms of sheer volume and expense, and the country has yet to see any discernible return on its investment in this area. There is no way to sustain human civilization without energy. Whenever there is a scarcity of this essential resource, economic development and progress in the affected area stall, and prices for goods and services skyrocket. A nation's capacity to develop marketable industries is directly correlated to the standard and reliability of its energy supply. In light of Nigeria's reputation for energy scarcity, it stands to reason that the country's manufacturing sector is struggling. Despite the federal government's policies, programs, and programs aimed at addressing energy issues in Nigeria for decades, the country's actual energy deficit remains unfathomable because of its reliance on non-renewable energy sources. Nevertheless, Nigeria's power-generating shortage remained a concern because the country's ability to generate electricity from non-renewable sources is inadequate to fulfill the demands of the country's rapidly expanding population and ambitious economic goals. The significant expenditures made by both the former and current administrations in the search for power stabilization in Nigeria have not alleviated the primary worry of power instability caused by the vast number of Nigerians utilizing non-renewable energy sources. Trade and income production in Nigeria have been impacted by this unpredictability. Abba [22] estimates that 70% of rural villages in Nigeria do not have access to electricity, which contributes to the country's poor rate of economic growth and the rise in rural-urban migration. This power insufficiency is a major issue in Nigeria. An estimated 90 million Nigerians lacked access to the national grid, according to data from the NERC website. A lack of renewable energy sources and the damage it does to the environment has essentially stymied progress in many areas, including manufacturing, the expansion of micro and small businesses, and long-term economic growth on a national and state level. Renewable energy, according to Newsom [23], might help close the huge electricity disparities in Nigeria's rural regions. The emergence of new grid technologies, such as concentrated solar power, as rivals to traditional, oil-based power production is making the expanding prospects for renewable energy in Nigeria increasingly apparent. Despite having a renewable energy master plan and plenty of access to renewable energy sources, Nigeria has lagged in developing and using renewable energy. One possible explanation is the higher price tag of renewable resources compared to fossil fuels. Making it financially viable to use these resources is essential for increasing the quantity of renewable energy. There has been a recent uptick in interest in incorporating renewable energy into sustainable development strategies, in part because of the growing commercial markets for renewable energy, which are changing funding priorities from governmental and international donor organizations to private companies and banks. Positive outcomes in sustainable economic growth, rural development, energy independence, decreased health expenses (related to reduced air pollution), and climate change mitigation have resulted from Nigeria's transition to renewable energy resources. Major advancements in energy efficiency and the cost of producing renewable energy have reduced the amount of capital required for critical applications, but renewable energy still cannot compete with fossil fuels on price. Capital expenditure is still necessary, although prices have dropped by almost 75% in the last five years. Finding early alternatives, like as renewable energy, is of paramount significance for Nigeria's economy as its reliance on fossil fuels would inevitably run out of steam at some point. Nigeria is well-positioned to integrate renewable energy into its power infrastructure, thanks to its plentiful renewable resources and the rising backing from the government. Consequently, the purpose of this research is to evaluate how renewable energy sources contribute to the growth of a sustainable Nigerian economy and the challenges facing renewable energy in Nigeria.

Literature Review

Conceptual Clarification

Energy

Work is possible because of energy. The "power to do work that produces light, heat, or motion, or the fuel or electricity used for power" is all that energy is defined as in the Cambridge English Dictionary.

Sources of Energy

The natural world provides us with a variety of energy sources that we may use to power our daily lives. In Nigeria, for example, there are two primary types of energy sources: renewable and non-renewable. Although these sources may be further categorized as either primary or secondary energy, we shall focus on renewable and non-renewable energy in Nigeria for the purposes of this research.

Renewable Energy

According to Dawn Stover [24], renewable energy refers to power that comes from non-stop, endless sources including the sun, wind, rain, tides, waves, and geothermal heat. Renewable energy sources will always be available, regardless of how much we use them. When we talk about energy that can be restored in a human lifetime, we're talking about renewable energy. What this means is that this energy source will be accessible to us indefinitely. Energy from wind, water, sun, geothermal, and biomass sources are all considered renewable. Renewable energy sources are those that can be replenished naturally and will never run out, regardless of how much energy is used. There is little to no environmental impact from using these energy sources. Nigeria is not excluded from the vast majority of the world's population when it comes to the availability of renewable energy sources.

Wind Renewable Energy Source

The wind powers a turbine, which in turn produces them. The use of wind mills to generate electricity for the wine industry is not new. It is simple to collect this energy source in many places of the globe, and it creates nearly little pollution. Despite the high cost, specialised equipment, and regular maintenance required, wind energy is a viable alternative to traditional energy sources like fossil fuels and nuclear power. Wind turbines convert wind into electricity, windmills mechanical power, and wind pumps water pumping or drainage. However, for this type of energy to be effective, the wind speed at a power site must be above 12 kilometres per hour.

Hydro Renewable Energy Source

The process of water falling from a height to a lower level generates hydroelectric electricity. A turbine in a hydroelectric power plant is propelled by water falling from a dam. The generator is powered by the turbine. Very little pollution is produced by this energy source. Also, it won't make the water worse. There are other uses for the water. When compared to fossil fuels, it is more affordable. One drawback is that when a dam is constructed, a large portion of land is submerged to create a lake. As a result, the local wildlife and humans are forced to leave their homes.

Solar Renewable Energy Source

This is the power that the sun produces. By using solar panels, we are able to harness the energy of the sun, which does not contribute to environmental damage.

Geothermal Energy Source

This source of energy is extracted from the Earth's interior, where it originates from the radioactive decay of elements and the heat produced during the planet's initial birth. The rocks and fluids in Earth's core contain all of this thermal energy.

Biomass Renewable Energy Source

The source of this substance is an organism that is either alive or has just died. Biomass has several potential use, including direct consumption or processing into biofuel and other energy products. Plant material, or biomass, is

burned in steam turbines to provide energy. Carbon, hydrogen, and oxygen are its primary components. Garbage, wood, trash, landfill gases, and alcohol fuels are the five separate energy sources that provide this kind of energy. Gases like methane and liquid fuels for vehicles like ethanol and biodiesel may be produced from this source of energy. Landfill gas, biomass, or methane gas is emitted when organic matter, including human and agricultural waste, decomposes.

Economic Development

Building local wealth, diversifying the economy, generating and maintaining employment, expanding the local tax base, etc. are all parts of economic development, which aims to enhance the economic well-being and quality of life of a country's citizens.

Sustainable Economic Development

When economic growth is balanced with social and environmental demands, we say that it is sustainable economic development. The goal of sustainable economic growth should be to improve people's living conditions without compromising their ability to do the same for future generations.

Sustainable Development

One definition of sustainable development is progress that satisfies current demands without jeopardizing those of future generations. objectives, such as the present sustainable development aim at the United Nations level, tackle worldwide problems including poverty, injustice, inequality, climate change, environmental degradation, and peace.

The term "sustainable development" refers to a set of practices aimed at preserving natural biotic systems while simultaneously increasing production via the efficient use of new or equivalent resources. In order to address the social, political, and economic issues that mankind faces, sustainable development brings together the idea of caring for the carrying capacity of natural systems.

17 Sustainable Development Goals

GOAL 1: No Poverty
GOAL 2: Zero Hunger
GOAL 3: Good Health and Well-being
GOAL 4: Quality Education
GOAL 5: Gender Equality
GOAL 6: Clean Water and Sanitation
GOAL 7: Affordable and Clean Energy
GOAL 8: Decent Work and Economic Growth
GOAL 9: Industry, Innovation and Infrastructure
GOAL 10: Reduced Inequality
GOAL 11: Sustainable Cities and Communities
GOAL 12: Responsible Consumption and Production
GOAL 13: Climate Action
GOAL 14: Life Below Water
GOAL 15: Life on Land
GOAL 16: Peace and Justice Strong Institutions
GOAL 17: Partnerships to achieve the Goal

Three Pillars of Sustainable Development

Progress in the areas of economics, society, and the environment are the cornerstones of sustainable development.

Economic sustainability communities and companies alike must share this burden. They are urged to be frugal and wise with their resources here. The goal of economic sustainability is to promote sustained economic

expansion over the long term without compromising the social, cultural, or environmental components of our interconnected world.

Social sustainability helps individuals. Air quality will improve and healthcare costs will go down if people, families, communities, and nations all work towards a more sustainable way of life. Due to their low maintenance requirements, renewable energy sources may help lessen the frequency and severity of droughts. A more equitable distribution of healthcare and education is one of the long-term aims of sustainable development, which aims to alleviate poverty and hunger across the world.

Environmental sustainability pay attention to the condition of the earth that we depart from. It promotes a lifestyle that recovers some of the resources we use regularly and produces very little waste.

Theoretical Literature

Theorizing on the relationship between economic development and power generation is a vast field. Energy Rebound theory is relevant to the present investigation.

Energy Rebound Theory

Opponents of energy efficiency initiatives seldom make the argument put forward by energy rebound theory. Since there is a decrease in energy use and emissions, the predicted decrease from energy efficiency improvements due to the induced behaviour adjustment of relevant economic agents is lower than what actually occurs [17]. Consequently, there is a tendency for energy consumption to rise as a result of lower energy prices, which in turn causes economic growth and development and more CO_2 emissions. Economic growth and progress are boosted by more efficient energy production and consumption. However, this might backfire if it leads to higher emission levels and greater environmental deterioration.

Empirical Literature

Ajayi et al., [5]. Researched the effects of renewable energy on Nigeria's environment, food supply, and employment prospects. Renewable energy resources have intrinsic advantages in reducing climate change and global warming occurrences; this study examined worldwide data on the linkages between energy and renewable energy adoption, country development, population expansion, job creation, rural-urban integration, and so on. Based on the study's findings, Nigeria's rural development program should include renewable energy sources for power production if the government is serious about sustaining its economic growth, especially in the agricultural sector and food security. It further demonstrates that renewable energy sources may reduce their impact on human-caused climate change.

Muhammed et al. [30] Using a disaggregated level of analysis, look at how electricity generation affected economic development and environmental quality in Japan from 1966 to 2014. In order to determine the long-term connection between the variables, the research used the ARDL bounds testing method of cointegration. The results of the bound test indicate that the variables under study are related over the long term. In addition, the long-term result based on ARDL shows that coal-generated electricity is not environmentally and economically viable, but electricity generated from hydro, natural gas, nuclear, and oil sources is environmentally and economically viable in Japan. By using the fully modified OLS (FMOLS), we can further validate the long-term, robust outcomes. So, while formulating policies for Japan's power generation, it's important to consider both economic development and environmental quality. When formulating power strategy in Japan, it is crucial to take steps to reduce the country's reliance on coal.

"The Effects of Renewable and Non-Renewable Energy Consumption, GHG, and ICT on Sustainable Economic Growth: Evidence from Old and New EU Countries" is the topic of Žarkovic et al. [29] investigation. The research shows that in order to achieve sustainable economic development, the economy, society, and nature around us must undergo slow but steady transformations. This would need a shift away from carbon-intensive economic models in the member states of the European Union. Another consideration for policymakers when choosing a sustainability strategy is the potential for reducing greenhouse gas emissions relative to other sustainability considerations. Therefore, to reduce carbon emissions, policymakers at the EU level and in

individual member states need enact sufficient regulations to do so. The study's findings provide strong support for the political choices made by the EU to raise the share of renewable energy in overall energy consumption, since they have a beneficial influence on economic development. These policies should be further solidified and included into next EU and member state initiatives. A solid foundation for harmonising national regulations with the EU legal framework in this area was laid by the adoption of the Renewable Energy Directive (EU) 2018/2001, the Energy Efficiency Directive (EU) 2018/2002, the Governance Regulation (EU) 2018/1999, and the Energy Performance of the Building Directive (EU) 2018/844.

This information is from Okonkwo et al. [20]. Learn About Renewable Energy in Nigeria and Its Possibilities and Obstacles. They discovered that Nigeria has a lot of untapped renewable energy potential and is one of the leading emitters of greenhouse gases, accounting for up to 1.01% of the world's total, due to its substantial usage of fossil fuels like crude oil to generate electricity. The growing concern for its long-term viability has spurred significant investment in research into renewable energy sources. In addition, trends show that crude oil will play a much less role in powering the energy economy going forward. Given these factors, they discuss the possibilities of renewable energy, the obstacles that can prevent it from being fully used, and the existing situation of energy projects, such as the renewable energy master plan that has been in the works for a decade. Also covered are the ways in which both urban and rural areas may reap the rewards of switching to renewable energy sources. They came to the conclusion that there are ways to lessen the environmental impact of fossil fuel extraction, which includes things like acid rain, melting glaciers, and global warming. If the potentials are put to good use and transformed into a readily available and reasonably priced energy source, the overall impact on the environment may be lessened. The long-term operating costs of renewable energy projects are significant, yet they are negligible or non-existent when contrasted with traditional energy sources. In order to satisfy current energy needs while also protecting the environment, the authors argue that we must investigate potential alternative energy sources.

Renewable Energy for Sustainable Development in India: Present Situation, Future Outlook, Obstacles, Job Creation, and Investment Opportunities is an analysis by Charles R.K. and Majid M.A. [29]. This paper's overarching goal is to showcase the many positive outcomes—including increased power output, investments, and job opportunities—that have resulted from India's growing renewable energy sector. Inadequate funding, research, government policy, and other issues were highlighted in this analysis as challenges for the renewable energy industry. According to the research, renewable technology uptake is hindered by the lack of thorough policy and regulatory frameworks. To attract more investment, the renewable energy industry needs clear regulations and legal processes. A lack of well-defined rules causes private sector project authorizations to be delayed. The government need to do something to entice private investment. The government should provide more funding to encourage research and innovation in this area so that we can overcome the lack of infrastructure and inadequate technology needed to build renewable technologies. A well-established renewable energy certificates (REC) policy might contribute to an efficient funding mechanism for renewable energy projects, the study said, and the federal and state governments should implement and strictly adhere to a "Must run status" policy to use renewable power. The study also called for strong initiatives from municipalities (local level) to approve projects based on renewable energy. To further disseminate information about renewable technology, the government should establish more educational and research organisations; this would aid in building the REC ecosystem.

F.A. Ekone [30]. Examined Is there a correlation between the use of renewable energy sources and GDP growth in Nigeria from 1990 to 2016? In addition, the research looked at whether or not renewable energy use was a causative factor in Nigeria's economic development. Descriptive statistics and econometric methods, such as regression, unit root, correlation, co-integration, and granger causality tests, were used to examine the gathered data. There was no statistically significant correlation between renewable energy consumption and GDP growth in Nigeria from 1990 to 2016, even though both variables were rising. Additionally, throughout the research period, renewable energy use did not correlate with economic development in Nigeria. Renewable energy usage has a negligible negative effect on GDP growth in Nigeria, according to the research. He suggests that renewable energy investment should be promoted and supported since it might help decrease the use of fossil fuels at home or fulfil rising energy demands without increasing fuel consumption at home, which would lead to more fuel exports and more money in the bank.

As of 2018, Hlalefang [13] was on the position. Analyse the relationship between renewable energy use and GDP growth in Indonesia. Results obtained using the ARDL bounds testing methodology. From 1990 to 2014, quarterly time series data were used. Finding a long-run link between economic growth, renewable energy consumption, carbon dioxide emissions, capital, and employment, the research used the autoregressive distributed lag (ARDL) bounds testing technique. Both the long and short term effects of renewable energy usage on economic development have been well-documented. It seems that renewable energy consumption, carbon dioxide emissions, capital, and employment all contribute to economic development in the long term, according to the results of the vector error correction model (VECM) approach. This study's results point to a need for coordinated action on the part of the Indonesian government, energy policymakers, and related agencies to decrease carbon growth and strengthen the country's renewable energy infrastructure. Additionally, the research suggests that targeted carbon pricing strategies are necessary to reduce carbon increase in Indonesia.

Evaluation of Literature Reviewed

Renewable energy and sustainable development have been the subjects of extensive study by scholars from a variety of academic disciplines and time eras. While conducting the literature review, the researcher found that the majority of studies used statistical methods such as the autoregressive distribution lad approach (ARDL), Johanson and Juselius cointegration technique, and Granger causality test to examine topics such as the relationship between sustainable energy and climate change, the effect of electricity production on economic growth, and the relationship between renewable and non-renewable energy sources and sustainable development in Nigeria and other countries around the globe. As an example, consider the following works: Ajayi et al. [5], Žarkovic' et al. [29], Okonkwo et al. [20], Charles R.K. & Majid (2020), Ekone F.A. [11], and Hlalefang K [13]. Based on their research, they came to the same conclusion: renewable energy is the future of long-term economic growth. Therefore, this research differs from others by using a descriptive-survey approach and a case study of Rivers State, Nigeria, to investigate the relationship between renewable energy and sustainable economic growth from 2000 to 2022.

Methodology

Research Design

This investigation made use of a survey research strategy. Survey researchers ask people to fill out forms so they may collect information. This method involves conducting a survey in order to collect data. Survey research design is a powerful tool for assessing trends and attitudes, even when used on a smaller scale.

Area of the Study

Studies were conducted in the state of Rivers. On May 27, 1967, the state of Rivers was created. This area, which is located in southern Nigeria, is called the Niger Delta. It comprises over 11,077 km2 of land. The state has the sixth-highest population in the country, according to the national population census of 2006 (NPC, 2006), making it the most populous state in the country. The capital of this state, Port Harcourt, is where we call home. Situated between the Atlantic Ocean to the south, the states of Imo and Abia to the north, Akwa-Ibom to the east, and Delta and Bayelsa to the west, this region is surrounded by abundant natural beauty. The state's 23 local government areas (LGAs) are home to a diverse range of ethnic groups, including the Abua, Andoni, Ekpeye, Engenni, Etche, Ibani, Ikwerre, kalabari, Ogba/Egbema/Ndoni, Okirika, and Ogoni. The coastal mangrove swamps and tropical rain forests make up the state's landscape. Most of the state's residents identify as Christians. A tiny minority adheres to more traditional values. The traditional occupation of the residents is farming, either crops in the interior or fish in the coastal sections. The state's abundance of crude oil has contributed to its rise to the status of one of Nigeria's wealthiest states. Along with two major refineries, two seaports, and an international airport, the state is home to a number of smaller businesses spread out throughout the landscape. It is home to the State Police headquarters, a divisional military barrack, a naval base, and an air force base. The number of public primary schools in the state is 2,805, while there are 243 public high schools. Two secondary schools are run by the federal government, in addition to the many private institutions. Three federally funded universities are located in Nigeria: The University of Port Harcourt, the Oil and Gas Polytechnic, and the Federal Government College of Education Technical. The state's greater learning system is comprised of seven institutions of higher

learning: Rivers State University, Ignatius Ajuru University of Education, Ken SaroWiwa Polytechnic, Elechi Amadi Polytechnic, and the schools of midwifery, nursing, and health technology.

Population of the Study

Each and every one of Rivers State's municipal governments served as the study's population. The state of Rivers is comprised of twenty-three municipalities. It is one of the biggest states in Nigeria, with a total population of 5,198,716 in the 2006 census and 7,303,900 in 2016, according to the national bureau of statistics. This represents an annual growth rate of 3.5%.

At 3.5% increase per annum = 3.5/100 = 0.035

Annual population rate X 2006 population = 0.035 x 5,198,716 = 181,955.06 = 181,955

Annual population growth = 181,955

Population growth rate from 2016-2022 = 181,955 X 7 = 1,273,685

Add 7 years' population growth rate to 2016 projected population

1,273,685 + 7,303,900 = 8,577,585

2023 population = 8,577,585

Sampling Size and Sampling Technique

Sample Size:

This study's sample size was established using the Taro Yamane formula.

Here is the formula proposed by Yamane [30]:

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

Where :

N = population of study

e = degree of freedom/significance at 5% (0.05)

1= constant

Substituting numbers in to the formula we have:

$$n = \frac{8,577,585}{1+8,395,630(0.05)2}$$

n = 399.9 = 400.

Sampling Techniques

The research used a sampling strategy based on purpose. For the sake of clarity, this study's sample consists of six (6) local governments out of twenty-three (23) LGAs in Rivers State. In this study, we choose to use purposeful sampling since it allows us to pick non-probability samples based on features found in the target population and the research as a whole. Furthermore, it aids the researchers in determining which demographics include the most extreme viewpoints. Two LGAs were chosen at random from each of River State's three senatorial districts; the six LGAs that made up the state are as follows: Port Harcourt, Obio/Akpor, Eleme, Oyigbo, Bonny, and Ogba/Egbema/Ndoni. This selection process was based on purposive sampling techniques.

Nature/Sources of Data

Data should be gathered from primary and secondary sources, as this research implies. A total of 400 citizens from all three senatorial districts in Rivers State were selected at random and given closed-ended questionnaires. Secondly, due to the features present in this selected LGA population group and the overall research, two LGAs were intentionally chosen from each senatorial district, for a total of six LGAs. The data for this research was derived from the analysis of the responses of the people who were given the questionnaire. Although the primary source of information for this study was the Nigerian Bureau of Statistics, supplementary sources included the Nigerian Population Commission. Here is how the state was divided and the sample was selected:

Table 1. Sectorial Distributions of the Questionnaires

Senatorial District	No. of L.G.A	Names of L.G.A	No. of L.G.A	Names of Selected L.G.A
Central Senatorial District	8	Emohua Ikwerre Etche Omuma Port Harcourt Obio/Akpor Ogu/Bolo Okirika	2	Obio/Akpor Port Harcourt
West Senatorial District	8	Bonny Degema Asari-Toru Akuku Toro Ogba/Egbema/Ndoni Ahoada East Ahoada West Abua/Odual	2	Bonny Ogba/Egbema/Ndoni
South East Senatorial District	7	Andoni Opobo/Nkoro Gokana Khana Eleme Oyigbo Tai	2	Eleme Oyigbo

Source: Authors compilation 2023

Method of Data Collection

Renewable Energy and Sustainable Economic Development (R.E.S.E.D.) was the name of the self-structured questionnaire that was used as a research tool in this study. The researchers were able to collect data that was pertinent to their study because of this. The questionnaire was carefully crafted to gather information from the participants while also catering to the specific needs and objectives of the research. Three components were used to develop the questionnaire. Identifying the respondents by their gender, age, employment, and state of origin was the primary focus of the first segment. The second one looks at how renewable energy influences long-term economic growth in Rivers State. Issue three of the study, which concerns the difficulties encountered by renewable energy sources in Rivers State, is finally addressed in the third segment. A 5-point Likert scale with the options "Strongly agreed," "Agreed," "Undecided," "Strongly disagree," and "Disagreed" was used in the survey. There are 27 parts to the instrument.

Validity/Reliability of Instrument

Professors at the University of Port Harcourt's Department of Economics reviewed preliminary questionnaire versions for content validity and suggested revisions before they were sent out to the respondents. In addition to the instrument, the researchers sent the lecturers a letter outlining his intentions in order to prove that the exercise was beneficial. In light of the suggestions put forward by these professors, we revised the questionnaire questions.

Administration of Instrument

Scientists personally gave the test to the people they had specifically chosen. In order to reach the designated population, the researchers introduced themselves and explained the purpose of the study. Furthermore, participants are instructed by the researchers on how to complete the survey. During the administration of the instrument, one research assistant helped the researchers. The researchers and their assistance needed six (6) weeks to finish administering the devices. To find the instrument's reliability coefficient, researchers gave it to 15 people and then utilised SPSS software and the Cronbach alpha technique to analyse the data.

Method of Data Analysis

To evaluate the replies from the respondents, descriptive statistics and non-parametric statistical methods were used as the instruments of data analysis. Data was also presented using descriptive statistical techniques such as tables, percentages, averages, and more. Comparatively, SPSS's Mean and Standard Deviation functions were used to analyse the two study issues using a 5-point Linkert scale. A mean threshold of 3.0 was used to assess the study questions. A mean score below 3.0 indicates that respondents do not agree with the research questions, while a score of 3.0 or above indicates that respondents do agree with the research questions.

Presentation of Data and Discussion of Findings

Data Presentation

The data was analysed in accordance with the study's objectives. Primary and secondary data was examined. In the main analysis, participants were defined by certain demographic factors. Age, gender, marital status, length of service, and all other demographic variables were summarised using percentages. For the descriptive statistics in the secondary analyses, we employed logistic regression, standard deviations, and means.

Table 2 Distribution and Retrieval of Questionnaires

S/N	Regions/LGAs	Questionnaire Distributed	Questionnaire Retrieved	Questionnaire Not Retrieved	Percentage of Retrievals
	Central Senatorial District				
	Obio/Akpor	66	52	14	78.79
	Port Harcourt	70	64	6	91.43
	Sub-Total	136	116	20	85.29
	West Senatorial District				
	Bonny	66	53	13	80.30
	Ogba/Egbema/Ndoni	66	51	15	77.27
	Sub-Total	132	104	28	78.79
	South/East Senatorial district				
	Eleme	66	48	18	72.73
	Oyigbo	66	50	16	75.76
	Sub-Total	132	98	34	74.24
	TOTAL	400	318	82	79.50

Source: Authors Computation, 2023.

The survey was sent to two LGAs in each of the three senatorial districts in Rivers State. In the selected LGAs, questionnaires were distributed in the commercial hubs of the senatorial district. Only 318 (or 79.50% of the total) of the 400 questionnaires were actually collected and filled out in their whole.

Each of the two LGAs got 66 questions, as shown in Table 2. The capital of the state, Port Harcourt, however, received 70 surveys due to its status as the state's administrative centre. The central senatorial district had the best response rate of 85.29% with 116 surveys that were totally completed and returned. Of the six LGAs in the

Rivers South/East senatorial districts, 72.73% of the population has taken the survey, while 91.43% have done so in Port Harcourt LGA in the Rivers Central senatorial districts.

Table 3. Demographic Characteristics

Details	Classifications	Frequency	Percentage	Cumulative Percentage
Gender	Males	243	60.75	60.75
	Females	157	39.25	100

Source: Authors Computation, 2023.

Table 3a Demographic Characteristics

Details	Classifications	Frequency	Percentage	Cumulative Percentage
Age	20-29 yrs	71	17.75	17.75
	30-39 yrs	144	36.00	53.75
	40andAbove	185	46.25	100

Source: Authors Computation, 2023.

Table 3b Demographic Characteristics

Details	Classifications	Frequency	Percentage	Cumulative Percentage
Marital Status	Married	255	63.75	63.75
	Single	145	36.25	100

Table 3c Demographic Characteristics

Qualifications	B.SC/HND	171	47.47	42.75
	M.SC/Phd	78	19.50	62.25
	Other Degrees	151	37.75	100

Source: Authors Computation, 2023.

Table 3d Demographic Characteristics

Occupations	Frequency	Percentage	Cumulative Percent
Civil Servants	89	22.2	22.25
Business Men/Women	167	41.7	64.00
Students	53	13.2	77.25
Commercial Transporters	75	18.7	96.00
Firms	16	4.00	100

Source: Authors Computation, 2023.

The demographics of the respondents from each of the six LGAs are shown in Table 3. Of those who took the survey, 60.75 percent were men and 39.25 percent were women. There was a sizable contingent of participants aged 40 and above; 185 individuals, or 46.25 percent of the total, were in this bracket, while 71 individuals, or 17.75 percent, were in the 20-to-29 age bracket. Just over half of the replies were submitted by young individuals. This data reveals that renewable energy is gaining traction among Nigeria's youth. A total of 255 people (or 63.75% of the total) are married to someone from the same household, whereas 145 people (or 36.25% of the total) are not in a committed

relationship. Port Harcourt and the Obio/Akpor Local Government Areas house the vast bulk of the Rivers Senatorial district's single citizens. Of the total number of undergraduates, 171 (or 42.75% of the total) have earned a bachelor's degree in law (LLB), a bachelor's degree in education (B.Ed., B., or Eng.), a higher national diploma (HND), or a blended degree. At least one member has a doctorate or master's degree; this is an advanced degree compared to a bachelor's degree in science, education, engineering, law, or higher national diploma (19.50%). The percentage of individuals with degrees below a Bachelor of Science or Higher National Diploma is 37.75%, or 151 individuals. They have a number of credentials, including SSCE, OND, Vocational Skills, and Known, but they also have talents that have not been certified. Renewable energy use is highest among Rivers State residents aged 40 and above, according to the statistics shown above

Data Analysis

In order to determine the degree of relevance for the research issue, the data for this study is presented and examined below using basic percentage and SPSS software.

Research Question One

What are the impact of renewable energy on sustainable economy development in Rivers State, Nigeria.?

Table 4. Respondents Perceptions on the impact of renewable energy on sustainable economy development in Rivers State, Nigeria

S/N	Factors	Mean	Standard Deviation	Decision
1	Renewable energy promotes energy efficiency which lead to sustainable development in Rivers State, Nigeria.	3.93	3.65	Agreed
2	It stabilize the nation's energy supply, sustaining socioeconomic development and protecting the environment of Rivers State and the nation as a whole.	4.17	3.73	Agreed
3	It stabilizes the supply capacity of energy and promote it consumption demand which brings about sustainable economy development.	4.05	3.72	Agreed
4	Renewable energy addressed the problems of energy security, energy diversification and reduction of greenhouse gas emissions in Rivers State, Nigeria.	3.55	3.51	Agreed
5	The use of renewable energy reduces climate change mitigation and air pollution that benefit not only to the economy but also the environment.	4.61	4.11	Agreed
6	Renewable energy helps in improving the living standard of residents of a nation which is in relation to sustainable development goal.	4.61	4.21	Agreed
	Aggregate mean	**4.15**	**3.82**	**Agreed**

Source: Authors Computation, 2023.

Using data from table 4, items 1–6 aimed to discuss how renewable energy has contributed to the growth of a sustainable economy 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, the standard deviation is 3.82 and the overall mean is 4.15 based on all the responses. In accordance with the conclusions drawn from the empirical research of Ajayi et al. [5], Muhammed et al. [30], and Hlalefang K. [13], it can be inferred that the respondents in Rivers State, Nigeria agree that

renewable energy has a positive impact on sustainable economic growth, ultimately leading to sustainable economic development.

Research Question Two
What are the challenges facing renewable energy in Rivers State, Nigeria.?

Table 5. Respondents Perceptions on the challenges of renewable energy in Rivers State, Nigeria

S/N	Factors	Mean	Standard Deviation	Decision
1	In Rivers State, progress on renewable energy sources has lagged behind that on the transmission infrastructure.	4.59	4.12	Agreed
2	A large-scale integration of renewable energy is not possible due to a lack of backup sources and energy storage systems.	4.18	3.78	Agreed
3	No strategy for the development of renewable energy has been implemented in Rivers State, Nigeria. .	4.87	4.39	Agreed
4	Lack of a sufficient bidding process to solicit investment funds for the development of renewable energy sources.	4.20	3.76	Agreed
5	A major barrier to the broad adoption of renewable energy technologies is the political climate.	3.15	3.11	Agreed
6	Disaster occurred in Rivers State, Nigeria, when renewable energy resources were used due to inadequate technology.	3.59	3.91	Agreed
7	Despite relatively good returns as compared to market norms, investors perceive a risk in the renewable business due to its lower gross returns.	3.54	3.38	Agreed
8	The number of developers in Rivers State with an interest in renewable energy projects is inadequate	4.31	3.78	Agreed
9	There is a substantial capital cost to developing a project, and newly formed developers, such as small and local developers, lack the institutional record and financial backing necessary to do so.	3.38	3.24	Agreed
10	Before extending credit, Rivers State banking institutions always work with large, reputable developers and contractors, as well as suppliers and operators with extensive expertise and proven equipment.	4.38	4.01	Agreed
11	There are significant financial hurdles to renewable energy projects in Rivers State since most financial institutions, including public and commercial banks, lack knowledge and experience in this area.	4.21	3.82	Agreed
12	The development of renewable infrastructure in Rivers State is hindered by the lack of proper or well-established research institutions.	4.42	3.96	Agreed
13	Developers in Rivers State, Nigeria, do not have access to customer service centres that can advise them on renewable energy projects.	4.48	4.10	Agreed
14	Challenges in allocating funds and timely budget releases prevent the renewable industry from advancing to its full potential.	4.13	3.65	Agreed
15	Conventional fossil fuels have received sufficient subsidies for a long time, leading many to believe that conventional fuel power	4.31	3.94	Agreed

16	is more important than renewable power (unfair structure of subsidies).	4.16	3.78	**Agreed**
17	There is a severe lack of workers in the renewable energy industry in Rivers State due to a lack of suitable and sufficient human resources.	4.23	3.82	**Agreed**
18	The renewable energy plant demonstration, training, operation, and maintenance staff in Rivers State is severely understaffed.	4.17	3.91	**Agreed**
19	In Rivers State, Nigeria, the populace lacks awareness programmes and has little information about renewable energy.	3.14	3.03	**Agreed**
20	Most Nigerians grow plants, thus those who utilise their land for agriculture aren't willing to part with it for renewable power plants.	4.22	3.82	**Agreed**
21	The population have a low per capita income and worry that renewable energy sources will be too expensive for them to implement.	3.12	3.05	**Agreed**
	Renewable technologies are losing popularity due to a lack of understanding of their environmental advantages and the widespread unfavourable misconceptions around them.			
	Aggregate mean	**4.04**	**3.55**	**Agreed**

Source: Authors Computation, 2023.

Table 5's items 1–21 attempted to handle the problems with renewable power in Nigeria's Rivers State. 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 3.55 was obtained from the total number of responses, which yielded an aggregate mean of 4.04. Consistent with the conclusions drawn from the empirical literature by Charles R.K. & Majid M.A. [8] and Okonkwo et al. [20], renewable energy faces a number of problems and hurdles in Rivers State, Nigeria, including a lack of qualified workers, insufficient funding, a lack of research, government policy, and an excessive dependence on non-renewable energy sources like crude oil.

Conclusion and Recommendations

Conclusion

With the use of Rivers State as a case study, this research looked at renewable energy and sustainable economic growth in Nigeria from 2000 to 2022. Based on the research, renewable energy is crucial for Rivers State's long-term economic growth. However, there are numerous obstacles to renewable energy's widespread use in the state and Nigeria at large. Nevertheless, if everyone pitches in, we can overcome these challenges and achieve long-term economic growth by switching to renewable power.

Recommendations

Here are some suggestions for Rivers State's policymakers and administration to consider if they want to see long-term economic growth in the state:

i) the policy for the development of renewable energy in Rivers State, Nigeria, and the distribution of related funds.

ii) provide a setting and set of procedures that would entice investors to put money into renewable energy projects in Rivers State, Nigeria.

iii) provide a hand in supplying green energy harvesting equipment to the state of Rivers in Nigeria.

iv) educate and prepare developers in Rivers State with an interest in renewable energy initiatives.

v) Banks and other lending institutions should sponsor renewable energy projects in order to spur their development and implementation.

vii) The people of Rivers State, Nigeria, need to be educated and made more aware of the value of renewable energy so that they may make informed decisions.

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