RENEWABLE ENERGY TECHNOLOGIES AND TOURISM DEVELOPMENT IN NIGERIA

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ABSTRACT

Nigeria has vast untapped renewable energy resources that are more than sufficient to fulfil and beyond the energy needs of both the current and future generations. Nigeria is significantly dependent on imported fuel derived from fossil sources. Nevertheless, fossil fuels encounter numerous constraints such as ecological contamination and a rising cost. Integrating renewable energy sources into the tourism industry has emerged as a top priority in order to enhance economic diversification and provide additional sources of revenue for the country. This study contends that the incorporation of renewable energy sources, such as solar, wind, and biomass, into the tourism sector has the potential to bolster and maintain the growth of tourism in Nigeria. The paper utilised a qualitative approach and employed the sustainable development theory as the theoretical framework for analysis. The problems of tourism development in Nigeria include the exorbitant expenses associated with power generation, particularly with the termination of subsidies. The lack of implementation of existing renewable energy legislation in Nigeria has a negative impact on the development of the tourism sector. The report suggests the integration of solar, wind, and biomass renewable energy technology into the tourism sector as a means to enhance the economic growth of Nigeria.

*Keywords***:** Renewable energy, Sidar, Wind, Bromass Tourism development, Nigeria.

INTRODUCTION

Adepoju and Akinwale (2019) noted that despite Nigeria's wealth of renewable energy resource (geothermal, solar, wind, biomass, hydro, and others) most of them go unused, despite their potential to drive the growth of the country's tourism industry. Insufficient availability of dependable and enduring electricity presents a significant obstacle in Nigeria's tourism industry. Presently, the Nigerian tourist sector significantly depends on fossil fuels to

generate energy, resulting in the release of carbon emissions, pollution, and substantial operational expenses. This is mostly attributed to the recent enforcement of the downstream petroleum products policy (Ibanga, 2022).

Additionally, Harder (2012) argues that transitioning to sustainable energy solutions in the tourism industry will not only decrease emissions and safeguard the environment, but also lower production expenses, provide additional employment, and foster economic prospects. In Nigeria, there are several policies in place regarding renewable energy, including the National Renewable Energy and Energy Efficiency Policy (NREEEP) from 2014 and the National Energy Policy from 2003. The Renewable Energy Master Plan (REMP) of 2005 and 2012, along with the National Renewable Energy Action Plan of 2016, have not been able to meet the tourism industry's expectations. Hence, this study contends that the implementation of renewable energy sources can enhance the nation's economy, employment rates, and environmental conservation, while also ensuring a pollution-free environment and energy stability in the tourism sector. This study investigates the relationship between renewable energy and tourist development in Nigeria, taking into account the context in which it is conducted. Several studies, including Awode (2022), Harder (2012), UdoAkpan, Ibanga, and Atakpa (2023), UNWTO (2018), and Audu et al (2019), have examined the relationship between renewable energy and tourist development. However, this work aims to address a remaining gap in the existing research.

Table 1: Possible sources of energy from renewable resources in Nigeria

Renewable energy	Maximum Capacity	Note
Solar energy	3.5KW/m/day to 7.0KW/m/day	
Sunshine (Hours)	4 to 7.5 hrs. / day	
Small hydro power	3,500MW	About 64.2 MW exploited
Biomass	Fuel wood	11 million hectares of forest and woodland
Wind	2 to 4 m/s at 10m height mainland	
Animal waste	245 million assorted (2001)	
Mega hydro power	11,500MW	Only 1972 MW exploited
Crops and agric residue	72 million hectares of agric land	

Source: Adapted from Chilakpu (2015)

LITERATURE REVIEW

Renewable Energy

According to the International Energy Agency's definition in 2002, renewable energy encompasses a wide range of energy sources, including solar, wind, ocean, hydropower, biomass, geothermal, biofuel, and hydrogen. Renewable energy, according to the Oxford definition, refers to energy obtained from sources that are almost inexhaustible, such as hydroelectric power, tidal power, and wave power. Yemi (2023) defines renewable energy as energy sources that are unlimited, naturally replenish-able, and incapable of being depleted.

Some examples of such sources encompass wind, solar, wave, trash, bio-fuel, and various more. The global focus has turned towards renewable and sustainable energy solutions in response to the growing need for energy, the rising price of oil, and the unpredictable availability of resources for conventional power production.

Tourism

"Tourism" is described by the United Nations World Tourism Organisation (2018) as a social and economic element that allows large numbers of people to leave their usual environment and go to another country or places for professional, business, or personal reasons. It is sometimes referred to as a non-commercial movement. Individuals that engage in tourism activities and incur expenses are commonly referred to as visitors or tourists (Paltrade report, 2013). Tourism encompasses the various interactions and relationships between tourists, tourism providers, government entities, and local communities during the stages of development and hosting (Mclntosh, Goeldner & Ritchie, 1995). Tourism is widely recognised as a major driver of gross domestic product (GDP), economic progress, and employment generation (UNWTO, 2018).

Theoretical Framework

Sustainable development

The relationship between renewable energy and tourist development in Nigeria is based on the theoretical framework of sustainable development. As defined by the Brundtland Commission (1980), sustainable development consists of priorities satisfying the demands of the present generation while guaranteeing that future generations can also meet their own expectations without any obstacles. Within the context of Nigeria's renewable energy and tourist sectors, this framework emphasises the imperative for solutions that effectively reconcile economic, environmental, and social factors. It offers a structure for evaluating the extent to which the incorporation of renewable energy sources like solar, wind, and biomass might support sustainable practices in the tourism industry in Nigeria.

Renewable energy and tourism development in Nigeria

Nigeria possesses significant renewable energy resources, including hydro power, geothermal, wind, solar, biomass, etc., which can be utilised to fuel the growth of its tourism industry. By enacting renewable energy legislation and making investments in this sector, Nigeria can stimulate tourism development and bolster its ongoing economic diversification endeavours. Tourism in Nigeria contributed to more than 6.97 percent of the country's Gross Domestic Product (GDP) and had an anticipated monetary value of $25.36 billion in 2022 (Awode, 2022 as referenced in Udoakpan, Ibanga & Atakpa, 2023). Additionally, Nigeria has a tourism economic potential of 7.5%, covering an area of 70,000 square kilometres of the country's land mass, as stated by the Federal Republic of Nigeria in 1999. (FRN, 1999).

The Country’s tourism resources are distributed across its six geopolitical zones, each offering distinct attractions. The spectrum of potentials includes lakes, rivers, mountains, ceramics, metal crafts, festivals, and more. The significance of tourism to Nigeria's economy (Oluwatuyi, 2012) cannot be overstated, alongside oil and agriculture. Therefore, adopting alternative energy sources such as wind, solar and biomass offer a chance for the revitalization of Nigeria's tourism economy. Potential tourist destinations such as the Mambilla Plateau in Taraba, Obudu Mountain Resort in Cross Rivers, and Yankari Games

Reserves in Bauchi among others have the capacity to be upgraded to meet international standards.

Despite the presence of tourism attractions, the country's ranking remained low or even worse (UNICEF, 2001) compared to other countries in Sub-Saharan Africa. This is mostly due to inadequate electricity generation and the failure to make use of the renewable energy sources that are available. In 2019, Nigeria had a power generation capacity of 7.5GW, with renewables contributing 15.6% of this total. The Nigeria Electrification Agency estimates that the country suffered a loss of approximately $29 billion in economic output as a result of inconsistent power supply. According to the 2021 renewables study published by IRENA, demonstrated that renewable energy sources have the potential to fulfil around 60% of Nigeria's energy requirements by the year 2050. By implementing this strategy, the country may reduce its reliance on oil by 65% and natural gas by 40%. (IRENA, 2021). Additionally, renewable energy sources could contribute to 47% of the total energy demand by 2030 and increase to 57% by 2040. This can boost tourism sector and generate revenue to Nigeria.

However, the Nigerian government has made effort towards the goal of supplying sustainable energy to all sectors, including tourism sector. As a result, the Renewable Energy Master Plan Policy was established in 2012. The renewable energy master plan serves as a strategic guide to fulfil the government's pledge in establishing the essential conditions for a sustainable energy provision for national progress, with the active involvement of the private sector. Similarly, in 2015, a policy was developed to address national renewable energy and energy efficiency in Nigeria, in response to the requirement for a distinct national document that exclusively addresses energy that is renewable as well as energy efficiency. The strategy acknowledges the significance of fuel substitution in mitigating the adverse environmental impacts of fuel usage. It explicitly notes that replacing wood-fuel, for example, will effectively decrease deforestation in Nigeria.

Furthermore, the 2016 national renewable energy action plan was aligned with the targets established by the ECOWAS renewable energy policy (EREP) for 2020 and 2030. The NREAP demonstrates the government's dedication to formulating ways to effectively carry out the goals of NREEEP. The action plan outlines a comprehensive strategy for Nigeria to achieve its goals in developing the renewable energy sector projection over a fifteen-year period from 2015 to 2030 (as shown in Table 2). These policies are designed to optimise the utilisation of renewable energy resources in Nigeria, with the aim of improving and fortifying several industries including tourism industry. Renewable energies provide environmental conservation, a clean and unpolluted atmosphere, energy stability, and economic benefits, as opposed to fossil fuels (Assadi et al., 2022; Bhowmik et al., 2017). Hence, it is imperative for present and forthcoming generations to depend on sustainable energy sources to fulfil their energy requirements across all sectors, including tourism.

Table 2: Projected sectorial demand for energy in Nigeria (7% growth rate)

S/N	Sector (%)	2005 Base year	2010	2015	2020	2025	2030
1	Services	6.13	5.30	5.39	5.72	5.78	5.49
2	Transport	30.80	27.62	24.56	22.92	22.27	21.62
3	Industry	13.81	28.92	37.01	40.75	44.69	48.78
4	Household	49.29	38.16	33.05	30.62	27.27	24.12
	Aggregate	100.03	100	100.01	100.01	100.01	100.01

Source: Adapted from Chilakpu (2015)

Adoption of Renewable Energy Technologies in Tourism Sector in Nigeria

Solar Energy

Nigeria has good solar irradiance for the adoption of solar technologies, with the best potential located in the Northern States. Nigeria experiences a variation in sunshine hours, with the extreme north receiving 9 hours of sunshine and the southern half of the country receiving 3.5 hours (Abdullahi et al., 2017). About 4.85 x 1012 kilowatt-hours (kW/h) of solar energy is received in the country every day, which is equivalent to the energy obtained from around 1.082 million tonnes of oil per day. The estimated sunlight per day is 6 hours, converted by a factor of 3.8 x 1023 kWIs (kilowatt-seconds) per day (Agbo et al., 2021).

The data demonstrates that the abundant solar radiation can give a significant quantity of energy can be used to address the unreliable energy supply, which results in lack of economic progress (Abdullahi et al., 2017). In Nigeria, solar energy can be harnessed through many means, such as the use of solar photovoltaic cells for rural electricity, additionally, solar energy can be utilised for powering cookers, crop dryers, water pumps, heaters, and other devices by harnessing the power of the Sun. Solar energy is experiencing a rise in utilisation in Nigeria, namely in areas such as the illumination of streets, pumping water, rural electricity supply, cold storage, and energising communication stations (Adekunle et al., 2015). An instance of a fully functional solar photovoltaic (PV) production facility has been established in Abuja by the National Agency for Science and Engineering Infrastructure (NASENI), capable of generating 7.5 megawatts (MW) of electricity annually. The company intends to enhance the capacity of the factory (Ozoegwu et al., 2017). The Delta state Government entered into agreement with Yutal Li Nigeria Limited for the building of a 100 MW solar power plant in 2016. The objective of this project is to encourage the use of renewable energy and support the development of micro, small, and medium scale industries (Audu et al., 2019). If solar energy is effectively harnessed, it has the potential to significantly improve the tourism business in Nigeria.

Wind Energy

Nigeria exhibits an average wind speed of 3.0 m/s in the majority of its regions, rendering it a highly favourable location for wind energy production. The wind speed ranges from 1.77 m/s to 4.5 m/s in the South-West, 3.30 m/s to 4.65 metres per second in the South-South region, 3.88 m/s to 9.39 m/s in the North-West, and 2.46 metres per second to 5.36 m/s in the North-Central (Oluleye and Adeyewa, 2016). Wind energy is theoretically viable in Nigeria, but its utilisation for the tourism industry is still in its nascent phase. Presently, there are no wind farms that contribute to the national power grid in Nigeria (Adedipe et al., 2018). Although small- and medium- wind turbines have found various uses nationwide, such as powering water pumps, charging batteries, electrifying small-scale companies, and conducting testing, they are insufficient for promoting the growth of tourism. The sole onshore wind turbine of significant size in the nation occurs within Katsina state (Rimi Local Authority). The projected capacity is planned to reach 10 megawatts (Mohammed et al., 2017).

The country possesses small-scale wind turbines, including a 5 kilowatt wind turbine system in Sokoto (Sayyan Gidan Gada) and one kilowatt wind turbine in Bauchi (Kedada) and Katsina (Goronyo). These turbines are specifically utilised for water pumping (Ebhota and Tabakov, 2018). The untapped potential and capacity for power generation of wind turbines

have not been fully harnessed, and the entire energy production is still in its nascent phase. Sadly, Nigeria has failed to utilise its potentials in energy from wind to improve the standard lifestyle for its citizens, especially those in rural areas. However, the Nigerian government can exploit wind energy to supply electricity to the tourism industry, namely in the northern regions (Shaaban & Petinrin, 2014). For instance, katsina State government established a 10 megawatts wind farm project at Lambar Rimi Village near Katsina City in Northern Nigeria. (Ladan 2012).

Biomass Energy

Nigeria has a wide range of biomass resources (wood, grassland, waste from agriculture, and waste products from urban and industrial activity. In 2012, Oyedepo calculated that Nigeria has a total biomass potential of approximately 200 billion kilogrammes per year and a bioenergy potential of roughly 2.58 billion gigajoules (equivalent to 61.67 million tonnes of oil equivalent). These values represent almost 51 percent of the country's overall energy usage in 2015. Oyedepo, (2012). About 80,000,000 cubic metres (4791.7 kilogrammes) of wood for cooking each year, mainly for domestic purposes, containing 6.0 x 109 megajoules of energy is consumed in Nigeria currently. Only a small fraction (5% to 12%) of the overall energy is used for purposes of household consumption, specifically for cooking. The collective utilisation of primary energy from wood and charcoal constituted around 32 percent to 40 percent of the overall energy consumption between 1989 and 2000. The projected nationwide demand for the year 2000 was 39 million tonnes. The consumption of fuelwood was primarily driven by cassava processing industries, household cooking which together accounted for 95 percent of the total.

The gas turbine project in Ebonyi State, which is megawatt-biomass exemplifies the utilisation of biomass in Nigeria, namely by harnessing plant husks to generate electricity. This project significantly contributes to the rapid growth of the state's tourism sector. Remarkably, Nigeria is abundant in biomass resources that have the potential to enhance tourist attractions if effectively harnessed and utilized, this can enhance economic growth in the country. The paper also argues that the federal government, state and local government can in corporate solar, wind, and biomass energy sources effectively mitigates environmental pollutants, resulting in a cleaner and healthier environment and generate revenues to the government in their tourism sector, as demonstrated in the model.

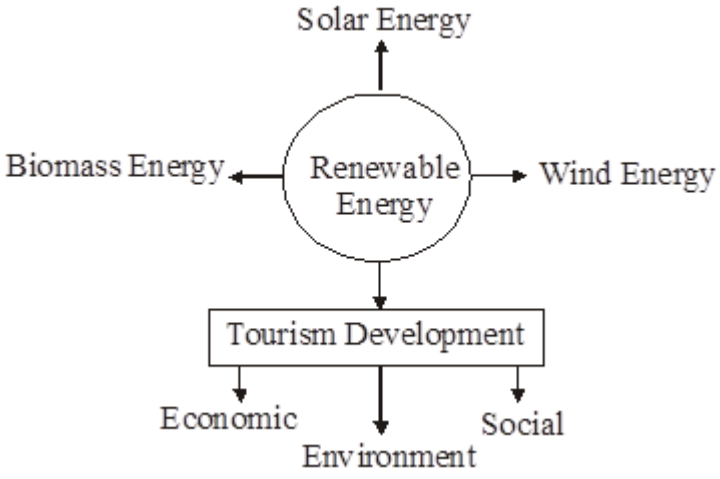

Fig 1: ***Conceptual map showing the nexus between renewable energy technologies and tourism development (Author, 2024)***

The model illustrates the position of this study regarding the untapped potential of renewable energy sources, such as solar, wind, and biomass, in Nigeria's tourist sites. This paper argues that due to the expensive nature of fossil fuel and the recent implementation of a policy to remove subsidies on downstream deregulation, the Nigerian government and private sector involved in the tourism and hospitality industry can effectively harness the capabilities of renewable energy for power generation.

How Tourism and Renewable Energy Technologies Boost some African Countries Economy

Diab et al., (2015) opines that tourism industry plays a crucial role in Egypt's economy. Due to the significant availability of solar and wind resources, Egypt has a favourable potential for the implementation of clean energy technology. Currently, Egypt's renewable energy utilization has been restricted to showcasing projects that exclusively employ this technology. There have been no significant endeavours to utilise renewable energy on a large basis. Furthermore, the utilisation of hybrid power systems incorporating multiple power generation technologies was absent (Kame & Dahi, 2005). In 1951, the tourist count in Egypt was 0.1 million. The number had a substantial surge to 1.8 million in 1981 and subsequently escalated to 5.5 million in 2000. The study examined multiple destinations for tourists in Egypt, namely the city of Luxor Giza, the city of Alexandria, the Qena region, and others (Diab et al., 2015).

The current allocation of energy projects in Egypt is mostly focused in Cairo, accounting for around 85% of the overall projects. The remaining 15% is concentrated in the vicinity of Aswan, where hydropower is created (Mostafa, 2014). Egypt possesses abundant wind and solar power resources. Consequently, it has become imperative to embrace renewable energy in Egypt due to the current energy constraint (Salem & Osman, 2016). In recent years, Egypt has seen a significant deficit in energy production. Consequently, Egypt has established a goal of generating renewable energy to account for 20% of the country's total electricity supply by 2020. This objective is twice the present proportion. (Salem & Osman, 2016). In 2016, wind farms in Egypt had an electricity producing capacity of 753 MW, according to the Energy Information Administration (2018). Egypt has set objectives to increase the share of renewable energy in its electrical producing portfolio. The country's objective is to produce 20% and 42% of its electricity from sources that are renewable by 2022 and 2035, respectively, to utilise its substantial renewable energy capacity (International Renewable Energy Agency, 2018), this has boost tourism and economy sector in Egypt.

Tourism and Renewable Energy in Ethiopia

Tourism is a significant source of revenue for Ethiopia. Electrifying rural tourism attractions is crucial for boosting their contribution to the national gross domestic product, which now stands at 10%, and increasing it to significant levels (Mekonnen, 2019). In a study conducted by Mekonnen (2019), the relationship between primary renewable energy sources and power production was investigated on small islands located in Lake Tana, which is recognised as one of Ethiopia's prominent tourist attractions. Due to Ethiopia's dependence on hydroelectricity as its primary energy source, the supply of energy is vulnerable to water scarcity. There is a substantial abundance of hydropower resources throughout the majority of the country. As observed by Tilahun, 2012, approximately 88% to 90% of Ethiopia's electricity production is derived from hydroelectric sources

The estimated total solar photovoltaic (PV) potential is 27,154 terawatt-hours per year (TWhIy) according to Aboagye et al. (2021). Ethiopia possesses a substantial resource potential for wind energy that is deemed highly favourable to generate wind power. The potential of wind energy in Ethiopia is estimated to be around 10,000 MW (Gaddada & Kodicherla, 2016). Hence, it is imperative for governments, businesses, and other relevant stakeholders to take various measures to address this issue. This should commence with prioritising energy efficiency and subsequently making investments in renewable energy. By harnessing alternative energy sources, Nigeria can revive its tourism sector, entice investors to support sustainability, and stimulate economic growth.

Tourism and Renewable Energy in Ghana

In western Africa, on the shores of the Gulf of Guinea, lies the country of Ghana. On its northern side, it has a contiguous boundary with Burkina Faso, meanwhile it lies in close proximity to Togo on its eastern side. The southern limit is delineated by the Atlantic Ocean to the east, whereas Ivory Coast is situated to the west. Ghana is a prominent African nation known for its economy and holds the distinction of being the first nation in the southern region of Sub-Saharan Africa to achieve independence. Owusu Asumadu-Sarkodie (2016) reported that the current estimate for the total population of Ghana is 30 million.

Ghana's oil supplies are greatly limited, resulting in a substantial reliance on petroleum-based fuel. The importation of oil has an adverse effect on the nation's economy. Energy security is very vulnerable to supply disruptions due to the reliance on fossil fuels. The primary renewable energy sources anticipated to be fully harnessed in the future encompass hydroelectricity, biomass, biofuel, as well as solar and wind power. This study evaluates renewable energy sources in relation to policy, market dynamics, and availability of food. The Act acknowledges renewable energy as an inexhaustible and perpetual energy source. Renewable energy encompasses a range of sources, such as hydroelectricity, marine energy, waste gas, biomass, wind, solar, and geothermal. Ghana has a plentiful supply of green energy which can be utilised to achieve sustainability. The Act aims to create enduring demand by attracting private and foreign investments, expediting privatisation initiatives, and promoting optimal and environmentally friendly development and utilisation of all renewable energy sources. The utilisation of energy sources should be conducted in a methodical and effective manner, with the objective of minimising any detrimental environmental impacts arising from endeavours to foster progress (Government of Ghana, 2011, ECREEE, 2015).

Ghana's government has set specific goals for its energy sector to promote the growth of renewable energy production within the country. One of the goals is to achieve a 10% proportion of renewable energy (specifically large-scale hydroelectric power) in the overall power generating combination by 2025. In order to meet renewable energy goals, the government is therefore increasing support for investors. These actions are intended to achieve the objectives specified in the Renewable Energy Act 2011 (Government of Ghana, 2011; Energy Commission and Ministry of Energy, 2019).

Challenges of Renewable Energy in Nigeria

Nigeria's industry has numerous hurdles in integrating renewable energy.

i. Technical Skill - The country lacks sufficient technical proficiency to create, implement, and oversee renewable energy projects. Furthermore, the country heavily relies on expertise from foreign sources rather than utilising its own.

ii. Financial and Fiscal Incentives - There is a lack of financial and fiscal incentives to expedite the growth of the renewable electricity market's supply and demand components.

iii. Insufficient Awareness - There exists a widespread dearth of knowledge on the advantages of utilising renewable sources for power generation.

iv. Insufficient Resource Assessment - The renewable electricity business lacks a reliable database for assessing resources, which hinders investment decision-making.

v. Insufficient Institutional Framework - The NERC's authority is restricted to energy plants with capacities of 1MW and more, leaving no regulatory body to grant licences for lesser capacities, which are frequently linked to renewable electricity.

vi. Resource Availability Intermittency - All renewable resources used for power generation are only available periodically and in a cyclical manner. The complexities of energy storage and system management are further compounded during situations of resource scarcity.

vii. Zero Resource Cost - In addition to bioelectricity, renewable electricity does not require any additional resources and is therefore free. While cutting operating costs is advantageous for renewable electricity systems, the primary difficulty lies in ensuring their overwhelming competitiveness.

viii. Renewable electricity technologies entail a substantial initial investment cost. This has hindered the system's ability to gain a significant presence in the electrical market.

viii. The energy industry in Nigeria has been deregulated and liberalised, allowing for the establishment of suitable pricing for power services in the country. This possibility would facilitate the competitiveness of renewable electricity in the market throughout the medium to long term.

x. Nigeria is confronted with an institutional issue in implementing renewable energy technology. As a result, the management and organisation of renewable energy initiatives in the country are unsatisfactory.

xi. Regulatory Policies: Regulatory policies play a crucial role in the effective adoption of renewable energy within a nation. Nigeria lacks a robust regulatory framework for renewable energy.

CONCLUSION AND RECOMMENDATIONS

In this study, we looked at Nigeria's renewable energy sources and their potential, analysing them through the lens of the country's energy policy blueprint. The study emphasised the problems and opportunities in renewable energy development and deployment.

1. The Nigerian government should include solar, wind, and biomass renewable energy technology into the tourism sector in order to enhance the country's economic growth and reduce unemployment in the Country.
2. The Nigerian government should adopt a renewable energy policy in order to improve her tourism sector as being seen in other African Countries like Ghana, Ethiopia, Eypt among others.

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