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Renewable Energy In Nigeria; A Backbone For Agriculture In A Climate Change Era

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Abstract
Prior to the advent of the petroleum era in Nigeria, agriculture served as a key pillar of economic sustainability, significantly contributing to the nation's GDP and income. However, climate change now poses significant threats to the sustainability of food production. To address these challenges, renewable energy solutions are essential to reduce ecosystem vulnerability and advance technological innovations for food security, particularly in underdeveloped and developing nations like Nigeria. This study explores the dynamics of climate change, the pursuit of renewable energy, and food security in Nigeria. Employing a historical research design, the study relied on secondary data obtained from sources such as the internet, journals, media publications, and libraries. A qualitative method was used for data analysis, guided by Jonas's theory of sustainable agriculture. The findings reveal that the Nigerian government has yet to adopt renewable energy as a dependable resource for agricultural activities. Additionally, the elite class in Nigeria and globally are identified as key opponents of climate change initiatives and renewable energy policies aimed at phasing out fossil fuels. Based on these findings, the study recommends that the Nigerian government move beyond geopolitical constraints and enact effective legislation to prioritize renewable energy as the primary source for ensuring food security.

Keywords: *Climate Change, Food, Security, Era, Renewable Energy.*

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I. Introduction

Agriculture was the cornerstone of Nigeria's economy before the emergence of the petroleum era. A sustainable agricultural sector, which incorporates innovative solutions to address both fundamental and applied food production challenges ecologically, is critical for economic growth (Lal, 2008). Previously, agriculture significantly contributed to Nigeria's GDP and economic development. However, this progress was undermined by institutional negligence. Currently, Nigeria's agricultural sector suffers from outdated technologies that fail to meet global standards, leaving it reliant on fossil fuels, which have severe environmental consequences (Lal, 2008).

Although renewable energy policy-making has been extensively researched, there is a lack of comprehensive frameworks in the international literature that outline sustainable measures for application. This paper aims to review methodologies and activities related to energy measures and propose a framework to guide policymakers, analysts, and citizens in adopting sustainable energy policies (Patlitzianas et al., 2008). Such an approach could promote the integration of renewable energy into agriculture and the power sector, particularly in underdeveloped and developing countries like Nigeria, which have abundant solar energy resources.

A natural resource is classified as renewable if it is replenished through natural processes at a rate equal to or faster than its consumption. Perpetual resources such as solar radiation, wind, tides, and hydroelectricity face no risk of long-term depletion. However, renewable resources like geothermal power, fresh water, timber, and biomass require careful management to avoid exceeding the environment's capacity to regenerate them, as highlighted in Garret Hardin's 1968 theory, *The Tragedy of the Commons.* This theory warns that unregulated use of shared resources by self-interested individuals can lead to resource depletion.

The concept of renewable energy inherently aligns with the sustainability of food production and environmental conservation. Unlike non-renewable resources such as gasoline, coal, natural gas, and diesel, renewable resources offer a sustainable yield. Renewable energy technologies harness primary energy sources that are not exhaustible, including solar, wind, geothermal energy, and biomass. Hydropower, replenished annually through the hydrological cycle, is also considered a renewable energy source (Frey & Linke, 2002).

Renewable energy is widely recognized as a sustainable energy solution that has gained significant attention in recent years. Given Nigeria's renewable energy potential and the urgent need to address environmental degradation, reduce reliance on fossil fuels, and prioritize sustainable development, immediate action is required to integrate renewable energy technologies into the country's energy mix.

Reducing greenhouse gas emissions requires the adoption of environmentally-friendly power generation technologies such as wind, solar, and fuel cells. A significant challenge lies in achieving leadership in greenhouse gas reduction while simultaneously developing research and manufacturing capabilities for sustainable technologies tailored to agricultural needs (Omer, 2008). According to Enerdata.net (2021), per capita energy consumption in Nigeria was 0.8 toe in 2021, with electricity consumption remaining relatively low compared to neighboring Sub-Saharan African countries. Total energy consumption has increased by only 5% since 2018, and in 2021, biomass accounted for 76% of total energy consumption, surpassing the regional average. Oil ranked as the second-largest energy source (14%), followed by gas (10%), both of which contribute significantly to environmental degradation.

Echeta et al. (2014) note that coal usage in Nigeria is minimal (less than 0.1 Mt in 2020) and limited to the industrial sector. The residential sector's share of electricity consumption has consistently risen since 2000, while industrial electricity consumption has slightly declined. According to the National Renewable Energy Action Plan (2016), Nigeria aims for 29% of its electricity production to come from renewable sources by 2030, including large-scale hydropower, which accounted for 20% in 2021, with a projected capacity of 13.8 GW.

Nigeria's current energy infrastructure poses significant risks to the agricultural sector's ability to sustain food production, support industrialization, and supply raw materials for manufacturing. The nation faces immense challenges in balancing energy demand and supply, while underdeveloped technological capabilities hinder the effective utilization of renewable energy. Reliance on fossil fuels exacerbates climate change, contributing to social and economic instability. International conventions and protocols, such as those outlined in various COP meetings, emphasize the need for global cooperation in addressing these challenges.

As stewards of future generations, a collective commitment is essential to translating these visions into actionable realities (Israel & Zeev, 2019).

Statement of the Problem

Nigeria possesses a rich and diverse agro-ecological environment capable of supporting the production of various crops, including wheat, cassava, yam, sorghum, maize, rice, potatoes, peanuts, cocoa, oil palm, and sugarcane. However, the country has failed to harness these potentials for sustainable food production. These aspirations have been undermined by extreme weather conditions influenced by the geopolitics of climate change and the selfish interests of a privileged few.

Urgent action is needed to mitigate the impacts of climate change and sustain food production while preserving natural resources and minimizing ecosystem disruption. Modernizing the agricultural sector and leveraging its value chain potential require the deployment of clean and affordable energy infrastructure. Renewable energy emerges as the most viable option due to its environmental sustainability benefits, aligning with Sustainable Development Goal 7 (Affordable and Clean Energy). This study projects that implementing clean energy policies will significantly mitigate the effects of climate change, a central factor in global warming discussions.

Approximately 80% of agricultural production variability can be attributed to fluctuations in weather conditions caused by climate change. In many underdeveloped and developing countries, where rain-fed agriculture is predominant, a favorable rainy season often results in increased crop yields, enhanced food security, and economic growth. Conversely, insufficient rainfall or natural disasters such as droughts and floods can lead to crop failures, food shortages, famine, property damage, loss of life, mass migration, and negative impacts on national economic growth.

Nigeria has been particularly vulnerable to extreme weather events, experiencing severe flood disasters and droughts that have disrupted economic activities, especially between 2013 and 2022. During this period, 82,035 houses were damaged, and 332,327 hectares of farmland were adversely affected.

Objective of the Study

The general objective of this study is to examine renewable energy in Nigeria as a backbone for sustainable agriculture in a climate change era.

The specific objectives are to:

i. draw a relationship between climate change and food insecurity in Nigeria.
ii. examine how renewable energy can ensure sustainable agriculture in Nigeria while preserving our ecosystem.
iii. examine the relationship between geo-politics and instability in agriculture policies in Nigeria.

Research Question

i. what is the relationship between climate change and food insecurity in Nigeria?
ii. Can renewable energy ensure sustainability in agriculture in Nigeria and still preserve our ecosystem?
iii. what is the relationship between geo-politics and instability in agriculture policies in Nigeria?

The study reviewed several related works by previous scholars to support the argument that Nigeria is facing significant challenges due to climate change and global warming, particularly in agriculture and food production. It highlights the urgent need to adopt renewable energy as a replacement for fossil fuels to sustain food production and preserve the ecosystem for future generations.

For instance, Ali et al. (2012) noted that renewable energy in farming systems encompasses various applications. Fossil fuels like oil are non-renewable, so adopting alternative methods for fertilizing land and controlling pests without relying on chemical inputs typically involves renewable resources. Such approaches reduce farmers' dependence on fluctuating oil prices. Renewable energy can also power various farming activities, such as pumping water for irrigation, livestock, or domestic use, lighting farm buildings, and running processing operations. Sources of renewable energy include solar energy, wind and water power, plant-based oils, sustainably sourced wood, other biomass materials, and biogas derived from the fermentation of manure and crop residues.

Ali et al. (2012) further observed that the use of solar energy for domestic, agricultural, and agro-industrial purposes has been practiced since ancient times. The increasing threat of acute shortages in commercial energy sources, combined with environmental pollution issues, has heightened interest in renewable energy technologies. Solar energy, being inexhaustible and environmentally friendly, holds significant potential for addressing these challenges. Solar technologies are expected to play a pivotal role in the near future through various thermal applications and decentralized power generation and distribution systems. For example, in India, the annual average daily solar radiation across the country is approximately 1800 J/cm²/day, illustrating the vast potential of solar energy for sustainable development. Drying of various agricultural produce in open sunlight is an age-old practice see picture **1** below.

Solar energy

Picture 1. shows solar pv panels providing green energy for agricultural growth. Source: ISSN:2231-6604 Volume 4, Issue 1, pp: 51-57 ©IJESET.

Ali et al (2012), says that Open sun drying of various agricultural produce is the most common application of solar energy. With the objective of increasing the drying rate and improving quality of the produce, natural convection and forced convection type solar dryers have been developed for various commodities. The movement of air in the forced convection solar dryer is through a power blower whereas in natural convection solar dryer air moves through the produce due to natural thermal gradient see picture **2** below**.**

Solar dryers

Picture 2. shows rice grains dried using solar Dryer: **Source:** ISSN:2231-6604 Volume 4, Issue 1, pp: 51-57 ©IJESET.

How wind energy can help farmers

Ali et al. (2012) highlight that farmers and ranchers are well-positioned to benefit from the expanding wind energy industry. They can lease their land to wind developers, use wind power for their farming operations, or even become independent wind power producers. Small wind generators, with capacities ranging from 400 watts to over 40 kilowatts, can supply energy for an entire farm or specific applications. For instance, in Texas and the western United States, many ranchers use wind generators to pump water for cattle. Compared to traditional fan-bladed windmills, electric wind generators are more efficient and reliable. They can also be more cost-effective than extending power lines and are more convenient and economical than diesel generators.

The concept of "net metering" allows farmers to maximize the benefits of their wind turbines. When a turbine generates excess power beyond the farm's immediate needs, the surplus electricity is fed back into the grid, effectively turning the electric meter backward. Conversely, when the turbine generates less power than required, the meter spins forward as usual. At the end of a billing period, the farmer either pays for the net electricity consumption or receives payment for net production from the utility company. Net metering laws and regulations are in effect in most states, providing farmers with a significant opportunity to capitalize on wind energy.

Picture 3. shows wind farms as a source of energy for the farmers. Source: ISSN:2231-6604 Volume 4, Issue 1, pp: 51-57 ©IJESET.

Dale (2001) asserts that the primary shortcoming of *Our Common Future* lies in its inability to address the significant social and political obstacles to achieving more sustainable agricultural development. This challenge may have been beyond the capacity of the 22-member committee, representing a broad political spectrum as it stood in 1984. A critical flaw in sustainable agricultural development is the absence of a corresponding political framework to support the concept. This issue, like all sustainable development concerns, is multifaceted.

The prevailing system is largely fueled by the "politics of more" and the "politics of react-and-cure." Politicians typically avoid addressing challenges until they can propose solutions that promise "more" — more progress, resources, or benefits. They never advocate for "less," as the idea of limits is inherently unpopular. Political parties, governments, and institutions like the OECD and the World Bank often resist the concept of "limits" because it implies scarcity, which is difficult to reconcile with maintaining public and institutional support.

Environmental protection politics often follow the model of react-and-cure. Politicians favor addressing first-generation environmental crises, such as severe river pollution or lake eutrophication, only when these issues reach catastrophic levels (e.g., rivers catching fire or lakes being declared "dead"). These scenarios allow politicians to take heroic action, promising not only to solve the immediate problem but also to deliver additional benefits, such as cleaner air and water, alongside economic incentives like grants, tax breaks, and subsidies to fund remedial measures. This approach fosters job creation and income generation, with positive feedback reflected in their favored metric, the Gross National Product (GNP).

Geopolitics and change of Regime in Nigeria

Realpolitik and changes in political administration (political instability) are critical factors reviewed in this study to support the argument that geopolitical dynamics and regime changes significantly contribute to the regression of agriculture and the economy in Nigeria. This issue stems from the selfish interests of incoming administrations, which often abandon existing agricultural policies in favor of repealing or disregarding them. Instead, they introduce new policies designed to benefit their political allies, particularly those within their region.

For instance, Oduntan et al. (2019) highlight that policy formulation in Nigeria often falls short of global standards for effective policymaking that drive national development. In contrast, developed nations rely on principles such as democracy, continuity, good governance, discipline, and sustainability, which have contributed to the success of foreign administrations.

To meet international standards, policymaking must engage all stakeholders, ensure equitable distribution, and be transparent, effective, and relevant. However, Nigerian political leaders often adopt unsustainable roles in agricultural policies and governance. Despite some commendable efforts, national development has not significantly improved. Successive administrations frequently introduce new agricultural policies rather than refining existing ones to enhance national development. These policies are often tailored to serve a select group, creating inconsistencies between regime changes and the nation's developmental goals.

As Oduntan et al. (2019) note, successive governments in Nigeria tend to treat the initiatives of their predecessors with contempt, favoring the formulation of new policies to appease their supporters. These new programs often fail to address critical issues such as food scarcity and economic development, instead serving as a means to placate political cronies and mislead the public.

Theoretical framework

This study adopts Jonas' theory of sustainable agriculture as the most suitable framework to analyze the role and responsibilities of the government in protecting the environment for future generations. Jonas' theory emphasizes environmental responsibility within the context of sustainable agriculture, asserting that technical interventions in nature are not ethically neutral. It argues that the ongoing environmental crisis can be mitigated through responsible actions that account for the threats to human civilization.

In the case of Nigeria, if the government assumes the responsibility of protecting the environment while ensuring consistent and sufficient agricultural production through a commitment to renewable energy, food security for future generations would be significantly enhanced. Thus, the study highlights the importance of the Nigerian government adopting new obligations that reflect human and environmental responsibilities. As group theory suggests, when group responsibilities are clearly defined, everything else aligns effectively.

Humanity bears a duty to future generations to maintain conditions that sustain life. Sustainable food production aligns with a new economic model emphasizing the conservation and management of natural resources and technological advancements to meet human needs while preserving the ecosystem for current and future generations. A key feature of this model is its strong connection to land conservation, water management, plant and animal genetic resources, and environmentally friendly practices.

To ensure sustainability, Nigeria's government policies must balance the needs of present and future generations with profitability, environmental health, ecosystem protection, and social and economic equity. According to the Food and Agriculture Organization (FAO, 2014), sustainable agriculture contributes to all four pillars of food security—availability, access, utilization, and stability—while maintaining environmental, economic, and social responsibility. Furthermore, systematic application of environmentally responsible agricultural practices, including the costs of environmental protection, is essential for achieving sustainable agriculture in Nigeria. This represents a significant step toward creating a healthier environment and ensuring long-term agricultural productivity.

II. Methodology

The historical research design was used, the researcher adopted secondary method of data collection, which involves the use of media, internet print, and libraries where various text books were sourced. Secondary types of data were used. Method of data analysis was qualitative, which is a method used to analyse secondary data sourced from libraries, internet and many other media prints like television and radio.

III. Results/Findings

Findings reveal that the Nigerian government has yet to adopt renewable energy as a reliable source for agricultural activities. The elite class, who benefit significantly as major exporters and importers of fossil fuel energy, consistently lobby against legislative efforts to promote renewable energy adoption in the country. Furthermore, political dynamics and regime changes have led to inconsistent agricultural policies in Nigeria.

Based on these findings, the study recommends that the Nigerian government abandon realpolitik and implement effective legislation promoting renewable energy as the primary and reliable energy source. This should include repealing laws that support the use of fossil fuels to achieve sustainable agriculture, preserve the environment, and align with global standards. Additionally, the government should embrace the recommendations and guidelines from global climate change conferences aimed at reducing greenhouse gas emissions to net-zero levels and achieving a 2.0-degree industrial limit, while fostering green and clean energy farming practices.

IV. Conclusion

The only viable solution to the challenges posed by climate change is to identify renewable energy sources to replace the declining availability of affordable and usable fossil fuels. Solar energy stands as the true renewable source, capable of providing energy for billions of years. Windmills, hydroelectric power, solar collectors, and photovoltaic cells are all renewable energy sources that could propel Nigeria's economy towards a

sustainable, long-term power supply, without harming the environment or the planet. Green plants, which act as natural solar energy collectors, were the original sources of the fossil fuels we use today. However, it is important to remain realistic about how much energy from agriculture can replace our current fossil fuel consumption, even though energy experts may differ on specific figures or percentages.

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