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Carbon Farming, Carbon Market, Climate Justice and Just Energy Transition in Reducing Carbon Emission in Nigeria (A Review)

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ABSTRACT

Aim of the Study: The study reviewed carbon farming, carbon market, and climate justice and energy transition in reducing carbon emission in Nigeria.

Methodology: The study being a qualitative review made use of literature reviews. A total of 400 papers on climate change, carbon farming, carbon market, carbon emissions, climate justice, and energy transitions were downloaded across various databases including (scopus, web of science, google scholar, and research gate). The authors peruse the 400 papers carefully to select the required ones based on the title of the research paper in focus. Papers not relating to the title of the research study were excluded numbering 372 leaving only 28 papers which focused basically on the research study of interest and concern. The included 28 scientific papers were thoroughly perused further and used for the review reports.

Findings: Based on the review results, there has been a universal call for the decarbonization of the global environment. This has necessitated the need for renewable energy and other forms of sustainable energy in Nigeria such as solar, wind, geothermal, hydropower, and bioenergy. Nigeria government has taken steps in ensuring a free, cleaner and safer environment via adoption of cutting edge technologies such as carbon farming, carbon markets, climate justice, and just energy transitions with few significant successes. Nigeria had transited from the conventional energy use to use of clean energy sources such as solar, wind, bioenergy, etc, though in gradual phases. Further findings revealed that there were

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some barriers to achieving energy transition plan and carbon neutrality in Nigeria. These includes; financial funding, technical-know-how, poor energy policy and energy market losses, infrastructure decay, environmental/ecological, legal and regulatory demands.

Conclusion: In conclusion, it should be noted that for a sustainable energy transition process and mitigation of climate change in Nigeria, the enabling policy frame works should be revisited.

Keywords: Carbon Farming, Carbon Market, Emission, Energy Transition, Nigeria.

Introduction

It's still believed that Nigeria's economy emits carbon which pollutes the atmosphere and contributes to climate change. For instances, many homes, industries, companies, etc still rely on generators and use of fossil fuels. One approach to lowering greenhouse gas emissions while maintaining a traditional economic structure is the low-carbon economy (Obada et al., 2024). By developing sustainable methods to manage a healthier and greener economy, this structure serves as a long-term goal in the effort to lessen the consequences of climate change. The Kyoto Protocol mandated that states reduce their carbon emissions, and the Paris Agreement of 2015 furthered this shift toward low-carbon economies (Kim, 2021). Concerted efforts have been made in reducing carbon emissions in Nigeria. Though, these emissions results largely from agricultural activities, industrial activities, burning of fossil fuels, etc. Farmer's plan to employ carbon farming to reduce greenhouse gas emissions in the atmosphere can be encouraged and strengthened in light of the climate problem. Sulfur can be eliminated from the atmosphere using carbon farming. Unlike other infrastructure-based mitigation techniques, carbon farming creates landscapes that provide advantages for both humans and the environment in addition to carbon storage. Beyond agricultural advantages, carbon farming has considerable promise for generating wider benefits. In order to mitigate almost 20 percent of Nigeria's greenhouse gas emissions from forestry, agriculture, and other land uses, the country has set a 2030 target to restore and save 380,000 hectares of forest and mangrove (Dioha et al., 2020). Climate justice looks at ideas like equality, human rights, communal rights, and historical responsibility for climate change. The distributive and procedural ethical aspects of and for mitigating climate change are the primary focus of climate justice. An approach to climate action known as climate justice; centers on the uneven effects of climate change on vulnerable or underprivileged groups of people. The goal of climate justice is to fairly distribute the costs of climate change as well as the efforts made to slow it down (UNDP, 2024).A significant structural alteration to the supply and consumption of energy within an energy system operates as energy transition, sometimes known as an energy system transformation. To slow down climate change, a shift to sustainable energy is now taking place. Since sustainable energy is mostly derived from renewable sources, it is also seen as renewable energy shift. The renewable energy transition is another name for sustainable energy, given its high degree of renewable nature. The present just transition intends to sustainably reduce greenhouse gas emissions from energy, primarily through the phase-out of fossil fuels and the conversion of as many processes as feasible to run on low-carbon power (Okoh and Okpanachi, 2023). A prior energy shift may have occurred during the Industrial Revolution in 1760, when coal replaced wood and other biomass, oil and then natural gas followed. Nigeria has engaged in a lot of activities to increase atmospheric carbon storage in soil and reduce excess carbon emissions. These engagements via carbon farming, carbon market, climate justice and just energy transitions aim to reduce greenhouse gas emissions at various levels. These encompass integrating cutting edge innovative technologies in controlling carbon emissions and accomplishing a safer environment free of carbon pollutions.

Problem Statement

Over time the use of poor land management techniques has continued to debase the ecosystem and environment causing harm and the release of greenhouse gases emissions which affects the overall environment and human populace. Land degradation has also contributed immensely to the declining state

of agricultural productivity, food insecurity, malnutrition and further increased poverty among the farming households in Nigeria. Unsustainable farming practices deplete soil fertility leading to low crop yields, low income and environmental exacerbation. The emission of greenhouse gases such as carbon dioxide, methane, and nitrous oxide has caused significant problems in Nigeria and has devastated the ecosystem, environments, biodiversity and human populace. Ugly effects of these emissions include, environmental pollutions and degradation, loss of plant species, land erosion resulting in fatal food loss and incessant health risks, etc.

Consequently the effects of multinational oil firms on rural regions and communities in Nigeria are a clear case of climate injustice. For instances, the glaring consequences of gas flaring and regular carbon emissions into the atmosphere causing air, land and water pollutions and ecosystem disturbances. This has affected agricultural activities, clean water supplies, rural livelihoods, and abuses of indigent human rights mostly in Niger Delta regions of the country. Again, the continuous use of fossils fuels in Nigeria has continued to generate issues and environmental problems and challenges. Fossils fuels releases poisonous gases into the atmosphere causing climate change, biodiversity loss and health related issues. It is on the account of the above enumerated issues that the study framework was conceived to project favourable policies to address these concerns.

Significance of the Study

The study is of great importance and significance to the Nigeria Economy in that it addressed the poor and unsuitable agronomic practices of crop growers that destroy the environment and ecosystems via the introduction of carbon farming which is more favorable and sustainable agronomic practice that reduces carbon emissions and projects environmental balance. The study highlighted the consequences of carbon emissions in Nigeria and proffers favourable solutions such as carbon trade-offs, carbon purchase and use of clean sources of energy such as solar, wind, geothermal, biogas, etc. These sources of energy are projected to reduce carbon dioxide emissions and the burning of fossil fuels in Nigeria. Furthermore, the reviews from the study will be very significant in formulating appropriate policies on sustainable land management, clean energy management, climate justice, and overall energy transitions in Nigeria. Information from the study will help government and policy makers make formidable and lasting policies or adjust existing ones to ensure smooth policy operations. For instances, it will draw government attention on the injustice meted on the rural communities especially in Niger Delta regions by multinational oil companies who pollute the environment through gas flaring activities and chart way for possible remedies and interventions. Agricultural practitioners will also benefit from the study by practicing sustainable agronomic methods such as the recommended organic farming as against unsustainable and inappropriate land/soil methods.

Study Objectives

The broad objective of the study was to review carbon farming, carbon market, and climate justice and energy transition in reducing carbon emission in Nigeria. The study achieved specific objectives such as;

i. Carbon farming and its associated benefits
ii. Carbon market and its trade-off framework
iii. Environmental benefits of carbon farming and carbon market
iv. Supply chain impacts of carbon farming and carbon market
v. Climate justice and injustice
vi. Energy transitions in Nigeria and its benefits and challenges

Methodology

The paper aligns with theoretical review of scientific published papers. A total of 400 papers on climate change, carbon farming, carbon market, carbon emissions, climate justice, and energy transitions were downloaded across various databases including scopus, web of science, google scholar, research gate, etc. After download, the authors peruse the 400 papers carefully to select the required ones based on the title of the research paper in focus. Papers not relating to the title of the research study were excluded numbering 372 leaving only 28 papers which focused basically on the research study of interest and concern. The included 28 scientific papers were thoroughly perused further and used for the review reports.

Results/Findings/Discussion

A Review on Carbon Farming

Nigeria agriculture is suffering from soil degradation and biodiversity loss as a result of modern agricultural production processes that are focused on short-term results and profits. Increased use of Carbon Sequestration (CS) techniques in land management can help to reverse these negative trends and will be critical in ensuring food security and mitigating climate change (Lin et al., 2013). Carbon farming (CF) will help to green the food supply chain by restoring the organic component of the soil, actively removing atmospheric CO2, increasing soil biodiversity, and improving crop nutrient and water holding capacity. Carbon farming is a viable method for slowing climate change, increasing agricultural land fertility and reducing greenhouse gas emissions. Carbon farming helps to achieve regional and national climate goals. This includes all carbon pools in soils, materials, and vegetation, as well as carbon dioxide (CO2), methane (CH4), and nitrous oxide flows (N2O) (Colen and Lambrecht, 2020). Carbon removal (sequestration and permanent storage of carbon in soils and biomass), avoided emissions (preventing the loss of already stored carbon), and emissions reductions (i.e., reductions in GHG emissions below present farm emissions) are all part of it (McDonald et al., 2021). All agricultural systems can mitigate, albeit the extent of mitigation varies by farm type and geography. Carbon farming models tries to scale up climate mitigation by compensating farmers for adopting climate-friendly farm management techniques (Sharma et al., 2021). Funding can come from both public and commercial sources, such as supply networks and carbon markets. These various funding sources present varied opportunities and hazards for farmers as well as for meeting climate goals (McDonald et al., 2021). While carbon farming focuses on reducing and removing emissions, it also creates a wide range of other positive effects with direct and indirect outcomes for farmers and farm productivity. Farming strategies that promote landscape-wide carbon storage also provide in-farm co-benefits for income, farm productivity, and soil health, among others. A special chance to manage land more strategically with additional advantages in numerous socioeconomic and environmental aspects is presented by carbon farming. The approach places a focus on implementing sustainable practices that primarily improve the uptake and sequestration of carbon from the atmosphere into arable land. This releases land's innate ability to absorb carbon on a significant scale. It ensures soil health and conservation, better structure and stability, nutrient availability, water and moisture retention, and irrigation efficiency. Efficient carbon farming also helps to improve water quality by limiting nutrient runoff. Farmers have more options to make money from carbon farming. Additionally, it saves money because to fuel economy and fewer inputs. It also makes long-term agricultural production management easier due to its sustainability. Since carbon farming naturally encourages environmental stewardship, particularly with regard to soil health, it has a significant potential to provide a variety of beneficial ecological effects. Choosing carbon farming is in line with sustainability objectives and produces better results.

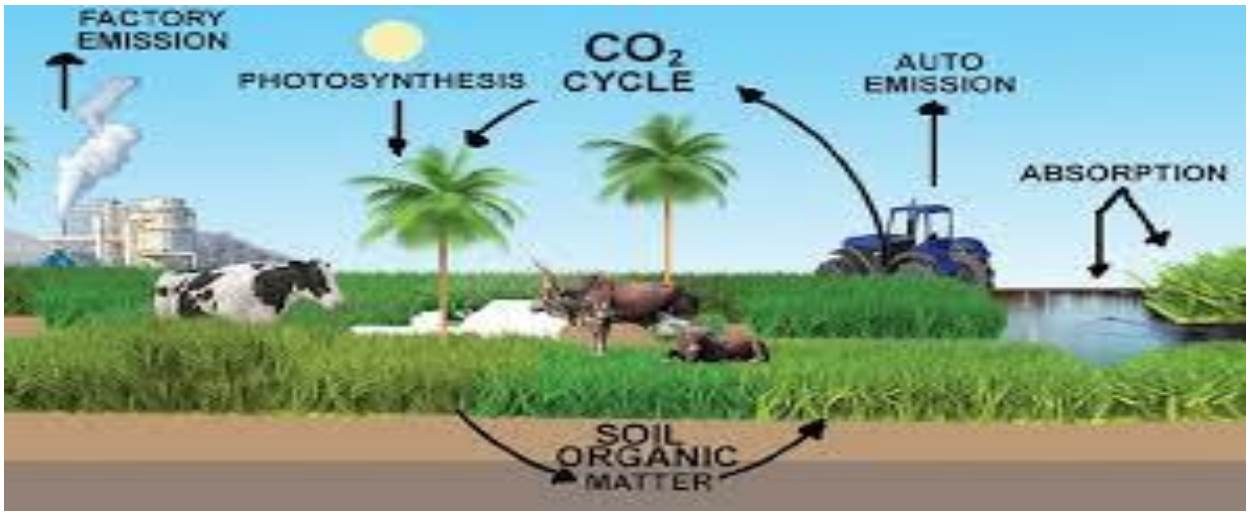

Figure 1: *Carbon Farming and Co2 Absorption*

Source: Sharma et al., 2021

A Review on Carbon Market

The Nigerian Federal Government is steadfast in its support of international initiatives to cut emissions that fuel climate change. Nigeria made its net-zero pledge public during the Glasgow COP26 in 2021 (FME, 2021). Nigeria's Climate Change Act of 2021 was passed after this, and the National Council on Climate Change (NCCC) was subsequently established. In order to design and execute procedures aimed at supporting low carbon emission, ecologically sustainable, and climate resilient economies, the Act applies to all Ministries, Departments, and Agencies as well as to public and private enterprises within the geographical limits of Nigeria. Nigeria plans to fulfill its obligations under the Climate Change Act and within the framework of international climate change treaties, particularly the Paris Agreement. Nigeria's participation in the carbon markets should be closely associated with its development agenda, Nationally Determined Contributions (NDCs), and achievement of the NetZero aim (NCCC, 2023). In order to meet the emission reduction objectives outlined in Nationally Determined Contributions (NDCs), nations may trade mitigation outcomes, or decreased or avoided greenhouse gas emissions. This is addressed in Article 6.2 of the Paris Agreement (FME, 2021). Establishing the framework for "Corresponding Adjustments," which aims to prevent double counting by transferring some or all of the mitigation outcomes from Nigeria and placing them in the ledger of the purchasing country under Internationally Transferred Mitigation Outcomes (ITMOs), or Other International Mitigation Purposes (OIMP), in the case of the private sector, is made possible by the structure and procedures outlined in Article 6. This is unquestionably the greatest way for Nigeria to fulfill its commitments to the global and national climates (NCCC, 2023). In keeping with the common goal of keeping atmospheric temperatures below 1.5oC, the government of Nigeria acknowledges that mitigation results alone would not be adequate to meet its climate objectives. This view is echoed by specialists in global climate change. This is necessary to prevent or lessen catastrophic weather occurrences and the disastrous effects they have on society and the economy. According to the World Bank's grade assessment, Nigeria's flooding catastrophe in 2022 caused around US$7 billion which is a direct economic harm. Without accounting for fatalities, this equates to 1.6% of Nigeria's projected GDP in 2021 (Yeboua et al., 2022). This foundational idea dictates that Nigeria's developing strategy for carbon markets must focus investments on enhancing the ability of our communities and institutions to adapt to climate disaster risk, while also creating new opportunities for land-based interventions, forestry, agriculture, and water conservation. To ensure that Article 6 cooperation mechanisms are implemented correctly, the NCCC has carried out a preliminary review of suitable governance frameworks and procedures. Utilizing the collaborative strategy described in the Paris Agreement, the NCCC prioritizes carbon market access by utilizing its network of institutional

partners, including government multilateral agreements, the Central Bank of Nigeria, the Ministry of Petroleum Resources, the UNFCCC, the UNDP, the World Bank, and the private sector (NCCC, 2023). In order to promote their involvement and maintain the appeal of Nigeria's carbon market, the NCCC emphasizes the significance of local private sector players and works to accelerate the decarbonization of their individual value chains. As required by its mission, the NCCC is naturally keeping a careful eye on industry-specific methane abatement initiatives.

Figure 2: *Carbon Credits and Emissions in Nigeria*

Source: Inah et al., 2022.

A Review on Environmental Benefits of Carbon Farming and Carbon Market

According to Zhang and Zhang (2020), the removal of carbon from the atmosphere requires innovative approach and as such carbon farming places an emphasis on implementing sustainable methods that primarily boost the absorption and retention of carbon from the atmosphere into productive lands. The primary goal of carbon farming is the reduction and removal of emissions, but it also has a variety of other positive effects on the environment that have both direct and indirect benefits for farmers and farm productivity. Through the re-vegetation of agricultural landscapes, carbon farming offers a special chance to boost ecosystem services and biodiversity (Lin et al., 2013). By minimizing erosion and nutrient runoff, purifying surface and groundwater, and increasing microbial activity and soil biodiversity, carbon farming practices have the additional benefits of restoring degraded soils, sustaining ecosystems and their surroundings, and reducing environmental and water pollution (McDonald et al., 2021). By employing techniques that are known to increase the rate at which CO2 is extracted from the atmosphere and stored in plant matter and/or soil organic matter, carbon farming is a whole farm strategy to improving carbon capture on working landscapes (Lin et al., 2013). As it inherently encourages environmental management, particularly with regard to soil health, carbon farming has a considerable potential to provide a variety of favorable ecological effects. One natural option is to sequester and store carbon by managing arable lands through carbon farming (Sharma et al., 2021). Carbon farming offers a special chance to manage lands more strategically with additional advantages in various socioeconomic and environmental aspects. It aims to enhance soil productivity, soil conservation, better environmental structure and stability, nutrient availability, water and moisture retention, and soil health (Hui et al., 2021). By preventing nutrient runoff, maintaining water quality, and maximizing irrigation efficiency, it contributes to the conservation of biodiversity, improves habitat for species richness, supports complex ecosystem structures, and aids in the

management of plant diseases, weeds, and pests as well as sustainable land use. It supports waste management and less reliance on harmful chemical inputs, pollution control, and lower greenhouse gas emissions associated with clearing vegetation, improving native vegetation, habitat, and environmental health, increasing soil fertility, lowering soil salinity, and preventing drought. Due to the huge emissions of carbon and its impacts on the environments which are becoming more rampant across the globe, there is great need to regulate carbon trading and emission activities across the continents of the world to restore the natural environment back to its domain (Li et al., 2018). Moreover, carbon emission reduction is the practice of keeping the environment from collapsing, such as loss of species, plants and animals, and loss of ecosystems due to carbon pollution and carbon trading activities. Protection of the environment aids the preservations of both of trees and animals, since they are dependent on the natural environment to survive. Carbon trade arrangements take into consideration the offer of carbon credits to lessen carbon emissions. Carbon trading is hinged on cap and exchange, a regulatory approach or mechanism that controls carbon exchanges and emissions and world nations have begun carbon exchanging projects to sustain the environment and liberate it from carbon emissions bringing about natural equilibrium (Zhang and Zhang, 2020). Carbon exchanging decreases carbon releases and transforms the overall environment into a conducive and impactful habitat for sustainable living, while improving the overall air, water and land quality making the total environment free from carbon pollutions. As of late, keeping up with the ecosystem and additionally, the environments requires carbon producing firms or individuals to pay for such emissions. Under such a framework, emissions are traded without endangering the environments. Carbon emission reduction represents a great deal of ecological balance and environmental sustainability. It allows for safer and free environmental pollutions. It helps the environments to regain its natural equilibrium and ecological balance at all times. Carbon trading regulations helps to conserve and protect our environment from adverse negative effects and/ or consequences. It integrates environmental concerns into emission trading while ensuring overall sustenance of the environment and its living organisms at large. Controlled carbon emission prevents environmental degradation and/ or denudation, and further prevents soil erosion, protect water quality and enhance wildlife habitation. Furthermore, environmental protection and sustenance is achieved when firms, individuals industries, organizations and governments involved in carbon trading and emissions engages international best practices in carbon emission exchanges (Simone et al., 2019).Incorporation of carbon emission regulatory standards supports the development of the overall environments. An ecosystem environmental balance requires coordinated efforts in environmental management and protections which have interrelationships with carbon emission controls of industries, firms, individuals, and organizations.

A Review on Supply Chain Impacts of Carbon Farming and Carbon Market

Significant sources of carbon emissions come from supply chain practices. By assuring seamless delivery of environmental practices without negative effects, it requires integrating the environment and its surrounds into supply chain activities (WorldBank, 2020). Organizations, businesses, and people involved in land usage and agriculture should adopt carbon farming and put its principles into practice in order to remove excess carbon from the atmosphere and to ensure efficient carbon supply sequestration. Adopting a wide range of good agricultural techniques on various farm types increases soil carbon storage while decreasing carbon emissions. The ability of the soil to meet the demands of the current farmers and the environment along the supply chain without destroying the lands and emitting carbon dioxide improves the environment. With regard to soil and land management, carbon farming offers a range of cutting-edge techniques that boost crop output and supply of food crops without having any negative effects (Colen and Lambrecht, 2020). It displays all procedures, methods, and treatments applied to safeguard the soil and improve its supply capabilities and outputs. Financial incentives, aid, and provisions for farmers are a cost-based supply chain management tool that supports policies for reducing carbon emissions (ICAP, 2020). In order to maintain an efficient supply chain, farmers and other land users must be informed of the importance of adopting effective sustainable soil management techniques and practices, as well as the need to avoid inappropriate agricultural and land management practices that destroy the environment and

cause an excessive supply of carbon emissions. Sustainable soil and land management practices are introduced by carbon farming to support agricultural production supply, environmental sustainability, and healthy ecosystems (Sharma et al., 2021). The development of carbon farming techniques is vital for the future of humans and natural supply systems since the effects of poor soil management supply chains are so severe in many regions of the world. Adopting carbon farming-related soil techniques that are ecologically friendly and highly productive in satisfying the food needs of the teeming population along the value chain supply systems is crucial due to the increasing pressure on the world's natural environment and resources. As a result, organic farming, bio-fertilizers, terracing, no-till, vegetal mulch, and other agro-forest management techniques have positive supply chain impacts on the environment, biodiversity, and ecosystems. Whereas land practices like bush burning, deforestation, indiscriminate vegetation removal, over grazing, use of marginal lands, and application of inorganic fertilizers pose a negative supply chain (Sharma et al., 2021). This had undermined efforts to store atmospheric carbon in soil and worsened carbon leaks and wasteful emissions that were harming the ecosystem and accelerating climate change. However, tax collection is a cost-based instrument of supply chain management that sets a decent cost for carbon emissions (ICAP, 2020). Maintaining efficient supply chain involves placing a cap or limit at various supply chain processes; for instance, placing monetary charges on excessive carbon supply emissions across emitting firms, individuals, industries, organizations, and in this manner deterring excess supply emissions. In case of/in terms of production, manufacturers need to acquire an underlying carbon emission limit from the public authority via the carbon emission centers. The manufacturers can purchase carbon discharges privileges from the carbon emission centers assuming that they surpass their underlying carbon emission limit toward the finishing of the production cycle; if not, they can sell their unused carbon discharges freedoms to the carbon emission centers, consequently making an empowering supply chain management without counter environmental impacts. The manufacturers likewise can overhaul their creation innovation to diminish carbon emission supply (Huiet al., 2021). Supply chain decarbonization presents a giant undiscovered chance for global environment activity. It can empower organizations with moderately little direct-discharge impressions to emphatically affect a worldwide scale. What's more, it does as such with an extremely restricted sway on eventual outcome costs. In the 21st century, carbon supply chain activities have been perceived by associations, firms, governments, and so forth as a result of its fundamental job in directing carbon trade emissions. This has prompted the productive development of the organizations and firms as well as the conservation of social and ecological qualities. Different administrative and exchange regulatory bodies like emission trading system, carbon cap and trade and carbon charge had been effectively contrived by various nations in managing carbon emission supply chains. Associations are dynamically smart and receptive to the carbon emission in this day and age, which connects with their operational tasks (WorldBank, 2020). In Nigeria, organizations have begun utilizing eco-accommodating machines, less carbon emitting vehicles and greener functional production technologies to diminish their carbon emission supplies which are helpful to their clients and customers. In addition, "carbon supply chain" operates a network of intermediary linkages via which carbon-free goods or services are provided to clients or end users with no risk of future harm. It provides enterprises with the ability to collect information about how successfully each segment of the supply chain benefits consumers without reservations or complaints in a sustainable context. This indicates that a supply chain with moderate carbon emissions can efficiently deliver any socially important commodities or services while posing no risk to the environment. In terms of economic performance, environmental care, and social responsibility, a sustainable carbon supply chain can generate long-term profit or benefit (Hui et al., 2021). Moreover, excessive supply of carbon dioxide into the atmosphere is very harmful and could degrade the ozone layers causing intense and severe heats. This trapped heat prompts the softening of ice covers and rising sea levels, which causes flooding and other ecological disturbances. Further, an appraisal report by the intergovernmental panel on climate change laid out that steady supply of carbon dioxides seriously influence our current environments and socio-economic livelihoods causing serious health challenges and other natural irregular issues such as poor air quality and water contaminations.

A Review on Climate Justice and Injustice

Climate justice evolves in reducing emissions and protecting the environment while also exploring ways to solve the climate catastrophe in a way that makes the world a more equitable, just, and fair place to live (Williams et al., 2023). Essentially, climate justice refers to the efforts we make to guarantee that individuals and the environment are treated equally in mitigating the effects of climate change by reducing the amount of fossil fuels we burn for energy production, and adapting to the changes we have caused. The goal of climate justice is to establish a human-centered approach in issues relating to climate change via development and human rights justification. This protects the most vulnerable people's rights and ensures that the costs and benefits of climate change are distributed fairly. The idea of climate justice holds that the costs and rewards of actions that contribute to climate change should be allocated equally. The three components of justice that are recognized as environmental justice are distributional justice, procedural justice, and recognitional justice (Williams et al., 2023). This paradigm is based on a long tradition of environmental justice study, advocacy, and vast knowledge. In order to combat injustice and environmental degradation, climate justice goes after the fundamental components of the social, economic, and political structures. Climate change, when combined with other social issues, is causing the "perfect storm" at a rate and scope that are unprecedented for humankind (Faiyetole, 2019). The implementation of climate justice policies is grounded on the principles of human rights, guaranteeing that all people and communities, irrespective of their financial circumstances or origins, have access to safe, clean water, food security, health care, and clean air. Considering human-caused climate change as an ethical and social issue, climate justice is a normative idea. A fair distribution of the costs and benefits of climate change mitigation as well as its effects underscores climate justice. That is fairness concerning accountability for climate change and fairness concerning the consequences of climate change. Consequently, climate justice is hinged upon these pillars,

- Just Transition
- Social, Racial and Environmental Justice
- Indigenous Climate Action
- Community Resilience and Adaptation
- Natural Climate Solutions
- Climate Education and Engagement

By 2050, Nigeria is predicted to have 9.4 million internal migrants due to climate change disasters making it the country with the second highest population on the continent with climate migrants. Interestingly a few significant steps have been taken in Nigeria in promoting climate justice, to mention include the relocation of persons and families affected by floods and other climate disasters to IDP camps (Kumari et al., 2021). Annoyingly, Nigeria government has not done much in contending with foreign firms' oil mining explorations with the local populations bearing the repercussions. The effects that multinational oil firms have on local communities is in reality a serious climate injustice in Nigeria, for instances, the consequences of gas flaring and regular carbon emissions into the atmosphere causing air, land and water pollutions and ecosystem disturbances. This has also affected agricultural activities, clean water supplies, rural livelihoods, and abuses of indigent human rights mostly in Niger Delta regions of the country. This correspondingly has caused civil unrest, innocent killings and property destruction, oil pipeline vandalization and heavy economic sabotage.

A Review on Energy Transitions in Nigeria

Energy transition describes the energy industry's move away from fossil fuel-based energy production and consumption systems, such as those based on coal, oil, and natural gas, and toward renewable energy sources like solar, wind, and lithium-ion batteries (Masri, 2023). The just energy transition tries to reduce carbon emissions and other greenhouse gas emissions (CO2) through innovative clean energy sources,

thereby safeguarding the environment and the natural resources that sustain life on earth. The fundamental idea underlying the energy transition concept is the social equivalency of its technical, environmental, and economic results. This necessity of controlling the social effects of decarbonization is reflected in the idea of a "just transition." In Nigeria, and other developing countries, energy transition has come into play emphasizing its need and importance in maintaining a suitable and clean energy environment (Olujobi et al., 2023).The present energy transition brought about by climate change is distinct because cleaner, renewable energy sources are urgently needed to replace fossil fuels due to rising concerns about the environment and global warming. Nigeria made the commitment to achieve net-zero emissions by 2060 when it developed its Energy Transition Plan (ETP) in 2021 with assistance from COP26. The initiative is approved by the government and offers partners and financiers a $23 billion chance (Olayande, 2022). The plan prioritizes renewable energy and lays out a strategy to lessen Nigeria's reliance on fossil fuels. The proposal suggests gas commercialization until 2030 and then a phase-out of fossil fuels gradually in order to achieve net-zero emissions by 2060. The initiative seeks to enhance air quality and lower greenhouse gas emissions from Nigeria. According to projections, Nigeria's greenhouse gas emissions might be reduced by up to 90% by 2050 and up to 45% by 2030 as a result of the shift. Significant economic potential and the creation of jobs are anticipated from the strategy in a number of economic areas, including electric cars, energy efficiency, and renewable energy (Atedhor, 2023). It's possible that by 2030, 5 million additional employments would have been generated. By the time of a full transition in 2060, an estimated US$1.9 trillion will have been invested in the industry. This includes programs to assist emerging industries like green hydrogen, electric transportation, and increasing capacity to open up new markets. Nigeria pledged to reach net-zero emissions by 2060 at the UN Climate Change Conference (COP26) in 2021 (FME, 2021). To do this, the nation must switch from using traditional fossil fuels to alternative renewable energy sources like solar and wind. Nigeria passed the Climate Change Act in 2021 as part of its commitment to the COP26 accord, which aimed to provide a workable framework for mainstreaming climate change management at the national level. Nigeria's electrical industry has recently undergone reforms that give governments the authority to control the production, transmission, and distribution of electricity (NCCC, 2023). These changes have created new investment possibilities, particularly for public-private partnerships (PPPs). Consequently, urgent steps are required to achieve Nigeria’s Energy Transition Plan;

i. **Determine and promote low-carbon energy options that are affordable for Nigerians with low incomes:** The ETP envisions the widespread use of clean technology like electric stoves, cars, etc. Given the portion of the population that lives in poverty today, research is required to develop viable and reasonably priced low-cost technologies for low-income families.

ii. **Novel approaches to the development of natural gas infrastructure**: Nigeria's ETP views natural gas as a transition fuel for the country's transition to a net-zero economy. However, changing energy systems can take decades due to the lead time for natural gas and the lifespan of infrastructure, which increases the danger of carbon lock-in. Nigeria, ought to engage in the construction of dual-use infrastructure, such as distribution networks and pipes that can handle synthetic fuels or green hydrogen.

iii. **Discouraging the use of biomass:** Approximately 70% of energy usage in Nigeria comes from biomass. Discouraging its use will help achieve a net-zero emissions energy system.

iv. Enhancing small and medium-sized businesses' (SMEs') energy efficiency: Energy efficiency is a crucial instrument for cutting Nigeria's carbon emissions since it lowers power consumption, which in turn lowers the quantity of fossil fuel that traditional gas power plants would have had to burn. Considering the importance of SMEs to Nigeria's industrial sector, widespread adoption of energy-efficient technology (such as sophisticated electric motors, fans, boilers, etc.) would be necessary to lower the sector's overall power consumption and hasten the transition to net zero by 2060 (Ogunmuyiwa and Okunleye, 2019).

v. **Emphasis on natural carbon removal methods**: There is need for Bioenergy with Carbon Capture and Storage (BECCS) in reaching net zero by 2060, implying the widespread use of CCS technology. Expanding Nigeria's forest cover through energy for growth, large-scale afforestation and reforestation programs can also provide a safer, more affordable carbon sink in the near future.

vi. **Examine integrated energy system strategies**: Integrated energy system planning is necessary for a net-zero emission energy system that is dominated by electrified end users and a flexible renewable energy source. In order to meet Nigeria's energy objectives in an economical manner, there has to be a greater level of integration between the transportation, heating, cooling, and electrical sectors. This would raise the overall energy system's flexibility and efficiency while also lowering its cost, adequacy, and dependability. Nigeria ought to investigate the possibility of incorporating mini-grids and electric cars with bidirectional charging capabilities into the primary grid. This may result in an adaptable and reasonably priced electrical supply system.

vii. **Promote a shift in the way people choose to travel**: Using electrical induced vehicles will help reduce transportation emissions. There are significant chances to reduce emissions by shifting behavior toward low-carbon transportation, but individuals must have a compelling motive to do so.

viii. **Lessen reliance on foreign funding for climate change**: Over time, Nigeria's energy and climate programs have been financed by outside sources, which have led to project execution delays because of donor financial uncertainty. Experience over the years has demonstrated that significant amounts of domestic funding are necessary to handle Nigeria's energy concerns than depending on outside sources.

ix. **Streamline climate-related policies**: Nigeria has more than fifteen policy frameworks pertaining to a sustainable energy transition, including its Nationally Determined Contribution, National Biofuel Policy, Renewable Energy Masterplan, and National Energy Masterplan, among others. Occasionally, these policy frameworks have various goals for example, varying the percentages of renewable energy technology intended for a specific year. These policy frameworks are administered by a number of disorganized government organizations, such as the Ministry of Environment, the Rural Electrification Agency, and the Energy Commission of Nigeria. Relevant institutions should work together to align policies, plans, and objectives in order to ensure the successful implementation of the ETP.

A Review on Challenges of Energy Transition in Nigeria

There are so many challenges facing energy transition in Nigeria. Nigeria's energy revolution requires about $1.9 trillion, which seems to be a major setback (Robinson and Njoku, 2023). Other setbacks include technological skill development, commercial, and policy aspects of the energy sector; lack of institutional support, poor infrastructure, ecological and environmental concerns, and legal and regulatory requirements. Consequent upon this include inadequate funding, energy loss, poor budgetary allocation, corruption, lack of good leadership, technological impediments, poor project maintenance and neglect, a lack of technical expertise, deteriorating infrastructure, gas shortages, high electricity costs and tariffs, population increase, economic growth, energy imports, environmental degradation, energy instability and social unrest and inter-communal conflicts, low energy supply and diversion of funds meant for ETP.

Conclusion and Policy Recommendation

Nigeria is known to produce carbon emissions and other greenhouses gases which are harmful to the environment and inimical to human existence and sustenance. These emissions results largely from agricultural activities, industrial activities, energy sectors, manufacturing companies, mining sectors and consistent use of biomass. Concerted efforts have been made in reducing carbon emissions in Nigeria via the use of cutting edge technologies and other important innovative techniques such as carbon farming, carbon markets, climate justice, and evolving just energy transitions. Few significant results have been achieved in these directions and more is expected in the near future. Consequent upon this, the following recommendations were made;

i. To fully realize the potential of Nigeria's carbon market, it is recommended that investor trust be increased, strategic alliances be fostered, education and awareness be promoted, and complete regulatory frameworks be developed.

ii. Changes in regulations and policies are necessary, primarily to foster an atmosphere that encourages firms to invest in energy transition. To facilitate the introduction and expansion of new technologies, considerable capacity building and skill development are also required.

iii. Policy reforms especially on climate change, climate justice and carbon farming should be strictly pursued and funds allocated in driving the process of emission reduction, distribution and environmental rehabilitations.

iv. Budgetary funds meant for mitigation of climate change and its related activities and just energy transitions should be religiously utilized to the fullest and not be diverted to other less or unimportant projects.

v. Policy education and robust awareness on climate issues, and just energy transitions should be publicly and evenly disseminated across the nook and cranny of the Nigeria environments to instill knowledge and build community participation across various stakeholders in achieving net zero emission targets by 2030.

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