

# Low Carbon Development in Support of Improving Environmental Quality in Nigeria

Okocha Michele<sup>1</sup>

<sup>1</sup>Yaba College of Technology, Nigeria

## Abstract

The importance of technology advancements in Low Carbon Development (LCD) and their significant effects on both environmental sustainability and economic growth are highlighted in this abstract. The transformational role of innovations is highlighted by examining them in several sectors, such as waste management, carbon capture, energy efficiency, renewable energy, and sustainable transportation. In addition to reducing carbon emissions, these inventions support the development of a green economy, job creation, and economic resilience. According to the abstract, as countries—including Nigeria—adopt technological solutions, they are paving the way for a peaceful coexistence of environmental sustainability and economic growth.

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## Introduction

Nigeria, one of the most populous countries in Africa, has enormous environmental concerns that must be addressed immediately for the sake of the country's sustainable development and the welfare of its people. A complex web of problems, such as air and water pollution, deforestation, and land degradation, have been brought about by the relationship between fast urbanization, industry, and environmental deterioration. The environment's general quality, biodiversity, and public health are all seriously threatened by these issues. The notion of Low Carbon Development (LCD) has surfaced as a strategy framework to steer Nigeria towards a more sustainable and eco-friendly path in response to these apprehensions.

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In Nigeria, deforestation and land degradation pose a serious threat to the environment. Large-scale forest clearing brought about by the growth of agriculture, logging, and urbanization has disrupted vital ecosystems and reduced biodiversity (Liu et al., 2019). Deforestation has global repercussions that go beyond national boundaries, exacerbating environmental concerns and accelerating climate change. Water supplies have become contaminated as a result of improper waste management, runoff from agriculture, and industrial discharges. This puts human and aquatic ecosystem health at risk, which has serious ramifications for a nation where a sizable section of the populace depends on natural water supplies for everyday requirements (Häder et al., 2020).

The interdependence of environmental quality, public health, and sustainable development highlights the significance of tackling these environmental issues. Low Carbon Development (LCD), a strategy approach that aims to reduce carbon emissions and promote sustainable practices across multiple sectors, has gained importance in response to this requirement. Adopting low-carbon principles is not only essential for reducing the effects of climate change, but it also supports Nigeria's participation in international initiatives to achieve environmental sustainability and carbon neutrality.

LCD calls for a fundamental change in how countries view economic growth, placing a stronger emphasis on lowering carbon emissions and using greener technologies. This strategy is especially pertinent to Nigeria, which is endowed with a wealth of renewable energy sources, including hydropower, wind, and solar energy. In addition to addressing the issue of air pollution, utilizing these resources for sustainable energy generation can support energy security and rural electrification (Chan et al., 2020).

Nigeria must take inspiration from worldwide LCD best practices in order to design an efficient and situation-specific course. Effective programs from nations like China, Germany, and Denmark provide us important insights on how to combine sustainable urban planning, renewable energy, and circular economy principles (Sun, 2020). These case studies provide a guide for how countries should strike a balance between environmental preservation and economic growth.

Nigeria must take into account the particular problems presented by its environmental issues as well as its distinct socio-economic context when it investigates the potential of LCD. It takes a thorough grasp of the current political climate, societal structures, and technical advancements to successfully integrate low carbon concepts. The National Policy on Climate Change and the National Environmental Policy (NEP), two of Nigeria's current environmental policies, offer the framework for environmental governance. But there is still debate about how well these policies work to encourage low-carbon development. It is essential to assess the advantages and disadvantages of existing policies in order to pinpoint areas that require development and to bring them into compliance with LCD's tenets.

The deficiencies found in the current regulatory framework highlight the necessity for a specific low carbon policy suited to Nigeria. In order to promote sustainable and low-carbon activities, the government, the corporate sector, and the society would all be guided by a strategic and well-coordinated strategy. This emphasizes how important it is to match national policies to the global climate goals in order to ensure that environmental stewardship practices are coordinated.

This introduction concludes by outlining the background of Nigeria's environmental issues and highlighting the urgent need for a paradigm change in favor of low-carbon development. A comprehensive and sustainable solution is required due to the interconnected challenges of deforestation, land degradation, and pollution of the air and water. Nigeria can put itself on a path toward a more sustainable and environmentally conscious future by investigating international best practices, realizing the value of a specific policy framework, and appreciating the need of coordinating domestic efforts with global climate goals.

### **Nigeria's Environmental Policies in Their Historical Context**

Nigeria's environmental policy has changed over time in response to the nation's industrialization, shifting socioeconomic landscape, and growing environmental issues (Ajibola et al., 2020). Gaining insight from the historical background of environmental regulations allows one to better understand how the country's commitment to environmental

stewardship has evolved. Nigeria had very little environmental policy prior to its independence in 1960. During this time, managing natural resources was the main priority, with a focus on protecting wildlife and forest reserves (Milleret al., 2019). One of the first laws addressing environmental issues was the 1918 Colonial Forest Ordinance, which sought to control logging and save forest resources. Nonetheless, resource extraction took precedence over comprehensive environmental preservation.

Nigeria saw substantial economic expansion and industrialization after gaining independence, which raised environmental constraints. With the founding of the Federal Environmental Protection Agency (FEPA) in 1988, the 1970s were a watershed decade. A crucial first step toward centralizing environmental management was taken by FEPA, which subsequently became the Federal Ministry of Environment. During this time, fundamental policies were formulated, including the National Environmental Policy (NEP) of 1989, which delineated the government's dedication to sustainable development, mitigation of pollution, and preservation of biodiversity. An important factor in the development of Nigeria's environmental policies was the Rio de Janeiro Earth Summit in 1992. The nation joined international agreements like the United Nations Framework Convention on Climate Change and the Convention on Biological Diversity. National policies were shaped by these international obligations, which emphasized the importance of environmental preservation and sustainable development.

The National Policy on Climate Change was formulated in 2012 as a result of the realization that climate change posed a worldwide threat. This strategy prioritized adaptation and mitigation measures in order to direct Nigeria's response to climate change. It emphasized how crucial it is to include climate factors into many areas, demonstrating a more all-encompassing approach to environmental policymaking. 1992 saw the passage of the Environmental Impact Assessment (EIA) Act, a noteworthy legislative achievement. It ensured that development operations took environmental sustainability into account by requiring the assessment of potential environmental implications before to the start of significant projects. The Act sought to reconcile environmental preservation with economic development, a reflection of the growing recognition of the importance of integrated policymaking.

Notwithstanding these policy advancements, problems still exist. There is need for improvement in the areas of implementation gaps, insufficient enforcement, and the requirement for a more focused attention on low carbon development. The historical background emphasizes how environmental policymaking is dynamic and how solutions change in response to both local and global issues. In line with worldwide trends, shifting to a green economy has received more attention in recent years. The Agricultural Promotion Policy, often known as the Green Alternative, and Nigeria's Economic Recovery and Growth Plan (ERGP) both emphasize the significance of sustainable practices for economic development. These initiatives show that environmental quality and economic growth are interdependent.

Conclusively, the historical background of environmental policies in Nigeria illustrates a progression from initial conservation endeavors to the creation of pivotal establishments and the development of fundamental policies. The changing environment highlights the country's dedication to tackling environmental issues, with a modern emphasis on climate change, sustainable development, and the necessity of making the shift to a green economy. To shape future policies that support Nigeria's drive for a more sustainable future and global environmental goals, it is imperative to comprehend this historical trajectory.

## International Views on Low-Carbon Development

In light of the pressing need to mitigate climate change, low carbon development, or LCD, has attracted attention on a global scale as a strategic approach to balance environmental sustainability with economic growth (Wimbadi & Djalante, 2020). An analysis of viewpoints on LCD from around the world indicates a range of experiences, effective projects, and lessons discovered that can help and motivate countries, like Nigeria, to embrace and put into practice sustainable techniques. The need to switch to renewable energy sources is one of the main concerns in global perspectives on LCD. Reputable countries like Germany have shown that incorporating renewable energy into the country's energy mix is both feasible and advantageous (Bridges et al., 2023). The goal of Germany's Energiewende (energy transition) plan, which was started in the early 2000s, is to gradually replace fossil fuels and nuclear energy with renewable energy sources including solar, wind, and other energy sources (Rechsteiner, 2021). This shift not only lowers carbon emissions but also improves energy security and encourages the development of green technology innovation.

Global carbon emissions are mostly attributed to cities, and sustainable urban planning has become an essential part of LCD. Copenhagen, Denmark, sets an excellent example with its dedication to achieving carbon neutrality. The city's emphasis on green infrastructure, which includes renewable energy systems, bike lanes, and green roofs, demonstrates how metropolitan areas may be planned to have as little negative environmental impact as possible while improving the quality of life for locals. China, the biggest carbon dioxide emitter in the world, has started along the path to a low-carbon future by emphasizing circular economy principles. Enacted in 2009, China's Circular Economy Promotion Law promotes material recycling, waste reduction, and resource efficiency. China wants to help the world achieve sustainable development by decoupling economic growth from resource consumption by adopting a circular strategy instead of a linear "take-make-dispose" model. The agriculture sector is included in the global LCD perspective, as sustainable practices are critical in lowering carbon emissions. The possibility for striking a balance between environmental conservation and economic development is demonstrated by Brazil's experience with sustainable agriculture in the Amazon region (Garrett et al., 2021). Programs that support zero-deforestation pledges, agroforestry, and responsible land use demonstrate how countries can lessen climate change while sustaining rural livelihoods.

Sweden's successful implementation of carbon pricing mechanisms provides valuable insights for nations considering market-based approaches to incentivize emission reductions. By putting a price on carbon emissions, Sweden has stimulated innovation, encouraged energy efficiency, and created economic incentives for businesses to transition toward low carbon practices. The effective application of carbon pricing mechanisms in Sweden offers useful lessons for other countries thinking about using market-based strategies to encourage emission reductions. Sweden's implementation of a carbon price has sparked innovation, promoted energy efficiency, and established financial incentives for companies to shift to low-carbon operations. Nigeria may learn a great deal from international viewpoints on LCD as it forges its own course toward sustainable development. The significance of a varied energy mix, sustainable urban planning, circular economy techniques, and the incorporation of sustainable agriculture are among the important lessons learned. Nigeria is able to adjust its strategy in light of its distinct socioeconomic situation by learning from both global triumphs and setbacks. To sum up, the worldwide viewpoint on Low Carbon Development offers a diverse range of approaches and experiences that countries, such as Nigeria, can utilize to achieve ecologically responsible and sustainable development. Germany, Denmark, China, Brazil, Sweden, and other countries' experiences highlight the variety of strategies that are possible and provide

important insights into the complex nature of low-carbon projects. Nigeria may strategically position itself to address environmental concerns, promote economic growth, and increase its resistance to climate change by using these global ideas.

### **The Economic Effects of Development Towards Low Carbon**

In addition to being a reaction to environmental issues, low carbon development (LCD) is a revolutionary strategy with significant economic ramifications. As countries move toward a low-carbon, more sustainable trajectory, they must negotiate economic changes that affect industries, jobs, and innovation. Analyzing LCD's financial effects sheds light on the ways in which these tactics might support resilience, job creation, and economic expansion. Diversification of energy sources is one of LCD's main economic effects. Reducing reliance on fossil fuels and adding renewable energy to the energy mix can help countries attain energy security, lessen their need on imports, and boost economic growth. In the developing green energy industry, switching to renewable energy sources like solar, wind, and hydropower encourages innovation and creates new job possibilities (Kylili et al., 2021). Strategic investments in renewable energy infrastructure have been shown to boost a nation's energy resilience and decrease its susceptibility to variations in global energy prices.

Using low-carbon techniques helps to create jobs in new industries that are involved in energy efficiency, renewable energy, and environmental preservation. The shift to a green economy, according to the International Labour Organization (ILO), might result in the creation of millions of new employment worldwide (van der Ree, 2019). This covers jobs in waste management, energy-efficient technologies, sustainable agriculture, and the production of renewable energy. In addition to addressing the issue of unemployment, job growth in the green economy also helps to maintain a workforce that is diverse and skilled. By lowering exposure to hazards related to resource depletion and climate change, LCD improves economic resilience. More economic stability is a result of sustainable measures like resource conservation and circular economy programs. Countries that place a high priority on LCD are better equipped to deal with the effects of climate change, including as extreme weather events, which can have serious economic repercussions. Countries can improve their economic resilience and lessen the cost of responding to unanticipated environmental difficulties by reducing the risks associated with climate change (D'Orazio, 2021).

The goal of low-carbon development encourages creativity and advances technology. Innovations in waste reduction, sustainable mobility, and energy efficiency are produced as a result of investments in clean technology research and development. These developments not only help achieve environmental objectives but also establish nations as industry leaders in the clean technology sector worldwide. Furthermore, encouraging innovation promotes economic competitiveness and the expansion of the knowledge-based economy. The application of financial tools, such green taxes and carbon pricing, can encourage companies and people to embrace sustainable practices. By internalizing the external costs of carbon emissions, carbon pricing systems encourage sectors to shift to low-carbon alternatives and lessen their carbon footprint (Klevtun & Nilsson, 2021). Green taxation, which levies fees on activities that affect the environment, encourages companies to adopt eco-friendly procedures even more. These financial instruments support environmental objectives while also producing income that can be used to fund further sustainable development projects.

Energy-saving techniques, which are essential to low-carbon development, save a lot of money for both homes and companies. Increasing the energy efficiency of buildings, transportation, and manufacturing processes can help countries cut expenses, become more competitive, and make goods and services more affordable. Both the public and private sectors can profit



economically from energy efficiency, which promotes a more economical and sustainable economic model.

In summary, low carbon development has economic effects that go beyond protecting the environment to create a more resilient, creative, and sustainable economy. A comprehensive vision of sustainable economic growth is made possible by the diversification of energy sources, the creation of jobs in the green economy, technology advancements, economic incentives, economic resilience to climate threats, and cost savings through energy efficiency. Achieving a healthy balance between environmental sustainability and economic prosperity is contingent upon a knowledge and use of the economic consequences of low-carbon development, which Nigeria and other nations are embarking upon.

### **Innovations in Technology for Low-Carbon Development**

In order to encourage environmentally friendly behavior, lower carbon emissions, and drive sustainable practices, low carbon development (LCD) mostly depends on technical advancements. Technological improvements are critical to the shift to a low-carbon economy across many sectors. Analyzing significant technical advancements sheds light on how countries, like Nigeria, might use innovation to advance their environmental objectives.

The broad use of renewable energy technologies is one of the pillars of low carbon development. Significant improvements have been made to geothermal, hydropower, wind, and solar photovoltaic (PV) systems, increasing their scalability, efficiency, and affordability (Maheshwar et al., 2023). The intermittent nature of renewable energy sources is being addressed by advances in energy storage technologies, such as batteries. This is increasing the dependability of renewable energy systems. Reliable and sustainable power sources are produced by the further optimization of renewable energy distribution and consumption through the integration of smart grid and microgrid technologies.

Reducing total energy usage and carbon footprints requires technological advancements in energy efficiency. Significant energy savings can be achieved by smart buildings that are outfitted with energy-efficient heating, ventilation, and air conditioning (HVAC) systems, as well as intelligent lighting and automation (Metallidou et al., 2020). Energy-efficient equipment and manufacturing techniques, like high-efficiency motors and appliances, have improved productivity in the industrial sector while consuming less energy. Energy management systems and real-time monitoring tools enable people and organizations to pinpoint areas for improvement and optimize energy usage.

Since the transportation industry contributes significantly to carbon emissions, developments in environmentally friendly transportation are essential for low-carbon development. Clean energy-powered vehicles, such as electric vehicles (EVs) and hybrid vehicles, are making significant progress in terms of cost, range, and infrastructure for charging. Furthermore, new developments in hydrogen fuel cell technology and biofuels provide sustainable alternatives for a range of transportation modes. Fuel consumption and emissions are decreased via intelligent transportation systems, which also include real-time traffic control and route optimization. The development of carbon capture and storage (CCS) technology has become essential in addressing emissions from current industrial operations. Carbon dioxide emissions from power stations and industrial facilities are captured by CCS, which then transports and safely stores the carbon dioxide underground. By preventing CO<sub>2</sub> from being released into the atmosphere, this device lessens the effects of climate change. The goals of ongoing CCS research and development are to increase its effectiveness, lower costs, and broaden its industry applicability.

Technological advancements in agriculture support environmentally friendly farming methods that increase output, lower emissions, and sequester carbon. Precision farming optimizes resource utilization, decreases waste, and lessens environmental impact through the use of data-driven technologies including sensors, drones, and satellite imaging (Linaza et al., 2021). Agroforestry techniques, which combine crops and trees, also improve biodiversity, store carbon in the soil, and offer sustainable food and lumber sources. Waste management technology advancements support both the creation of clean energy and the circular economy. Anaerobic digestion and incineration with energy recovery are two examples of waste-to-energy technologies that turn organic waste into biogas or power. These developments lessen reliance on fossil fuels by addressing the problem of waste management and assisting in the production of renewable energy.

Blockchain technology is being investigated in the context of carbon markets to improve carbon trading's efficiency, traceability, and transparency. Blockchain ensures the integrity of emission reduction programs by enabling the construction of transparent and safe digital ledgers for the tracking and verification of carbon credits. By simplifying the purchase and selling of carbon credits, this technology builds confidence amongst those involved in the carbon market.

In summary, technology advancements play a critical role in achieving the objectives of Low Carbon Development by providing workable solutions for the waste management, transportation, energy, and agricultural sectors. Achieving a low carbon future depends on the ongoing development and application of these technologies, as Nigeria and other countries work toward sustainability. Through adoption and investment in these advances, nations can promote economic expansion while simultaneously mitigating the effects of human activity on the environment.

## Conclusion

To sum up, technology advancements are essential to Low Carbon Development since they provide workable solutions for a variety of industries. Innovations in waste-to-energy, sustainable agriculture, and renewable energy not only lessen environmental problems but also promote resilience and economic growth. As countries like Nigeria adopt these advances, they open the door to a rich and sustainable future, proving that pursuing low-carbon growth is not just necessary for the environment but also a means of achieving economic vitality.

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