

## **Climate Change and Building Sustainability in Nigeria: The Implications and the Way Forward**

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**Abstract:** Natural events and human activities are believed to be contributing to an increase in average global temperatures. Climate change has become a global concern, and its impact has continued to affect and threaten human life and, to a large extent, and the livelihood of most people across the globe. The study examined climate change and building sustainability in Nigeria, its implications, and the way forward. The paper focused on the implications of climate change on buildings, the economic impacts of climate change in Nigeria, and strategies to mitigate climate change impacts on buildings. The study also revealed that Buildings contribute significantly to climatic changes and their impacts on the natural environment. Sustainable buildings can reduce greenhouse gas emissions, minimize energy consumption, conserve water resources, and enhance resilience to climate-related risks. On this basis, the study concluded that the issue of climate change and building sustainability has significant implications for the environment, society, and economy. Nigeria, like any other country is experiencing the adverse effects of climate change, including increased temperatures, extreme weather events, and rising sea levels. These impacts pose a threat to human health, livelihoods, and infrastructure. Addressing climate change through building sustainability in Nigeria requires a multi-faceted approach involving awareness, policy, finance, collaboration, research, and community engagement. One of the recommendations made was that there is a need for increased awareness and education about the importance of sustainable buildings and their role in climate change mitigation and adaptation. This can be done through public campaigns, training programs, and educational initiatives targeting architects, engineers, policymakers, and the general public.

**Keywords:** Climate Change, Building Sustainability, Implications Way Forward and Nigeria.

### **Introduction**

The definition of climate change is the shift in weather patterns over time as a result of things like anthropogenic activity or vulnerabilities in the environment. Climate change has gained international attention, and its effects continue to have an impact on and threaten human life as well as, to a considerable extent, the livelihood of the majority of people worldwide. It is thought that both natural occurrences and human activity are causing an increase in the average world temperature. Carbon dioxide (CO<sub>2</sub>) and other greenhouse gases are the main contributors to this. Millions of people's welfare is being negatively impacted by Nigeria's unfavorable climate conditions. Growing seasons have been thrown out of alignment for a nation whose agriculture is

dependent on rainfall due to persistent droughts, flooding, off-season rains, and dry spells. Alarm bells are ringing with lakes drying up and a reduction in river flow in the arid and semi-arid regions. The result is fewer water supplies for use in agriculture, hydro power generation and other users. The main suspect for all this havoc is Climate Change. Scientific studies show snow is disappearing rapidly.

Building sustainability is essential for both reducing climate change and adapting to it. Sustainable structures can lower greenhouse gas emissions, consume less energy, preserve water, and increase risk resistance to climate-related threats. Nigeria must overcome a number of obstacles to create sustainable buildings, including a lack of awareness, poor legislation and regulations, and budgetary limitations. According to Odjubo (2010), buildings have a considerable impact on climatic changes and how they affect the ecosystem. According to research, buildings are responsible for around 50% of the global carbon emissions. Approximately 90% of adults, according to other researchers, spend the majority of their waking hours indoors. It is therefore necessary to minimize problems that occupants may face in terms of comfort and climatic risks. According to Zubairu (2012), a sustainable building design is necessary to reduce the issues faced by building inhabitants. Buildings can last for a very long time, and during that time they continue to use energy and emit greenhouse gases (American Institute of Architects (AIA) 2010; De Wilde and Coley, 2012). Therefore, making a building sustainable now will be beneficial both now and in the future. Buildings that can be made sustainably are able to adapt to changing climatic conditions and lessen their effects. Through sustainable design, sustainable buildings are also affordable and attainable, particularly when stakeholders are committed to guaranteeing the sustainability of buildings. By implication, building designs would require specific inputs from current climatic indices to make them mitigate and adapt to a changing climate.

Climate change hazards are almost as serious as nuclear weapons dangers. Nigeria must continue to disregard the possible effects of climate change adaptation measures on its oil-based economy. Nigerians should start implementing policies to minimize their greenhouse gas emissions because of the harm that climate change is causing to their country's economic, social, and environmental resources. It is essential that all available resources be focused on finding ways to diversify the Nigerian economy and move it away from fossil fuels, both in terms of production and consumption. Only such a plan can prevent the nation's economy from collapsing if steps to combat climate change are put in place. The most crucial action to be performed is to increase Nigerians' environmental awareness. No matter their status, every person must be aware that the earth is rapidly losing the capacity to sustain the natural resources on which we all rely, endangering the national economy. They ought to take protecting the environment more seriously. Not only is this the moral thing to do, but nature depends on itself for its own survival; we cannot exist without nature. We can only save ourselves by protecting the environment. For the building sector, climate change presents both enormous challenges and opportunity. Adapting to the changing climate requires sustainable design practices, resilient construction techniques, efficient use of energy and resources, and a focus on occupant comfort and well-being.

### **Concept of Climate**

According to Britannica (2023), climate is the long-term summation of the atmospheric components (and their changes) that, over short time periods, produce weather. Climate is the conditions of the atmosphere at a specific area over a long period of time. The meteorological conditions that predominate in a particular region or zone have traditionally been referred to as the climate. The most contemporary definitions of climate consider it to be the sum of years' worth of weather and atmospheric behavior in a certain place. (Climate Europe 2020) A region's climate is determined by the typical weather there over a longer length of time. A description of a climate includes information on, e.g. the average temperature in different seasons, rainfall, and sunshine. Also, a description of the chance of extremes is often included. Climate refers to the

kind of weather that's typically expected in a region. Climate is the long-term pattern of weather in a particular area. The weather can change from hour to hour, day to day, month to month or even year to year. A region's weather patterns, usually tracked for at least 30 years, are considered its climate (National Geographic Society, 2023).

According to Wikipedia (2023), climate is the long-term weather pattern in a region, typically averaged over 30 years. More rigorously, it is the mean and variability of meteorological variables over a time span spanning from months to millions of years. Some of the meteorological variables that are commonly measured are temperature, humidity, atmospheric pressure, wind, and precipitation. In a broader sense, climate is the state of the components of the climate system, including the atmosphere, hydrosphere, cryosphere, lithosphere, and biosphere, and the interactions between them. Climate is determined by the long-term pattern of temperature and precipitation averages and extremes at a location. Climate descriptions can refer to areas that are local, regional, or global in extent. Climate can be described for different time intervals, such as decades, years, seasons, months, or specific dates of the year (climate.gov, 2023). Climate is region of the earth having specified climatic conditions. It is also the average course or condition of the weather at a place, usually over a period of years, as exhibited by temperature, wind velocity, and precipitation (Merriam-Webster, 2023). An area with particular weather conditions is called a climate. The typical weather conditions in a particular area It is also the general feeling or situation in a place at a particular time (Longman 2022).

According to Oliver (2018), climate in a narrow sense is usually defined as the average weather, or more rigorously, as the statistical description in terms of the mean and variability of relevant quantities over a period of time ranging from months to thousands or millions of years. The classical period for averaging these variables is 30 years, as defined by the World Meteorological Organization. The relevant quantities are most often surface variables such as temperature, precipitation, and wind. In a wider sense, climate is the state, including a statistical description, of the climate system. Climate is the thermodynamic and hydrodynamic status of the global boundary conditions that determine the concurrent array of weather patterns. Lower-case climate is the statistical characteristics of the weather assemblage at various places, or typical weather. Climate is a description of the climate system in terms of statistics. (IPCC, 2013)

### **Concept of Building**

According to Collins (2023), a building is a structure that has a roof and walls, for example, a house or a factory. A building is a structure that has a roof and walls, for example, a house or a factory. Buildings apply to either a finished or an unfinished product of construction and carry no implications as to size or condition. It also refers to a completed structure, usually a large and imposing one. Building generally implies a useful purpose (houses, schools, business offices, etc.). A building is a relatively permanent enclosed construction over a plot of land, having a roof and usually windows and often more than one level, used for any of a wide variety of activities, as living, entertaining, or manufacturing. A building is a structure that has a roof and walls and stands more or less permanently in one place. A building is a manmade structure that has a roof and walls and stands more or less permanently in one place. A building is any physical structure that is erected on or in the land to provide shelter and protect man from the adverse effects of the weather, such as rain, wind, snow, heat, temperature, etc. (Akpeli, 2019), Building means that which is built, a structure or edifice. A building is actually a roof and wall structure. Building is the process of putting structures together for the purpose of human settlement, among others. Moreso, building construction refers to the techniques and industry involved in the assembly and erection of structures, primarily used to provide shelter. (Ask Difference 2023), A building, or edifice, is a structure with a roof and walls standing more or less permanently in one place, such as a house or factory. Buildings come in a variety of sizes, shapes, and functions and have been adapted throughout history for a wide number of factors, from building materials available to weather conditions, land prices, ground conditions, specific uses, and aesthetic reasons. It refers to the art of constructing edifices, or the practice of civil architecture.

According to the Dictionary (2023), building is a relatively permanent enclosed construction over a plot of land, having a roof and usually windows and often more than one level, used for any of a wide variety of activities, such as living, entertaining, or manufacturing. A building is a kind of structure that is built with materials, including a foundation, plinth, walls, floors, roofs, chimneys, plumbing, and building services; fixed platforms; verandas, balconies, cornices, or projections; part of a building or anything affixed thereto; any wall enclosing or intended to enclose any land or space; and signs and outdoor display structures. For example, houses, factories, shopping malls, hospitals, etc. Building or housing is the most fundamental need for humankind. It shelters us. When we see or hear the word building, we imagine that a building is tall and has a roof, walls, rooms, etc. Building is the act of constructing something. It is any relatively permanent enclosed structure on a plot of land with a roof and windows. Anything built or constructed is also known as a building. Building is the act, business, or practice of constructing houses, office buildings, etc. Building is something that is built, as for human habitation (Free Dictionary, 2023).

### **Concept of Building Sustainability**

According to the Australian Building Sustainability Association (2023), Building sustainability means living in harmony with the natural environment, considering the social, environmental, and economic aspects of decisions, and reducing our footprint through a less energy-, water-, and material-intensive lifestyle.

Srinivas, (2015), stated that green or sustainable building is one that can maintain or improve the quality of life, harmonize with the local climate, tradition, culture, and environment in the region, conserve energy, resources, and recycling materials, reduce the amount of hazardous substances to which humans and other organisms are (or may be) exposed, and protect the local and global ecosystems throughout the entire building life-cycle. Sustainable buildings are designed and operated so that materials are used and reused productively and sustainably throughout their life cycle. (Ebersole, 2022), Sustainable architecture for buildings facilitates the creation and responsible management of a healthy built environment based upon efficient resource and ecological principles. Sustainably designed buildings strive to lessen their impact on the environment through energy and resource efficiency, which minimizes non-renewable resource consumption, enhances the natural environment, and eliminates or minimizes the use of toxic materials.

### **Concept of Climate Change**

Climate change is any systematic change in the long-term statistics of climate variables such as temperature, precipitation, pressure, or wind sustained over several decades or longer. Climate change can be due to natural external forcing (changes in solar emission or changes in the earth's orbit, natural internal processes of the climate system) or it can be human-induced (Climate Europe 2020). Climate change is a long-term shift in the average weather conditions of a region, such as its typical temperature, rainfall, and windiness. Climate change means that the range of conditions expected in many regions will change over the coming decades. This means that there will also be changes in extreme conditions (Canada, 2020). Climate change refers to changes in the Earth's climate at local, regional, or global scales and is most commonly used to describe anthropogenic, or human-caused, climate change (Ramkumar, 2020).

Palmetto (2023), Climate change is the long-term increase in the earth's average surface temperature and the large-scale changes in global, regional, and local weather patterns that result from that increase, caused by a significant increase in the levels of greenhouse gases that are produced by the use of fossil fuels. Climate change is the significant variation of weather patterns over long periods. It is the varying environmental conditions that influence the planet's weather patterns. Climate change is a long-term shift in the average weather conditions of a region, such as its typical temperature, rainfall, and windiness. Climate change means that the range of conditions expected in many regions will change over the coming decades. This means



that there will also be changes in extreme conditions. Climate change is exacerbating both water scarcity and water-related hazards (such as floods and droughts), as rising temperatures disrupt precipitation patterns and the entire water cycle. Climate change is exacerbating both water scarcity and water-related hazards (such as floods and droughts), as rising temperatures disrupt precipitation patterns and the entire water cycle, (UNICEF 2020). Climate change is the global phenomenon of climate transformation characterized by the changes in the usual climate of the planet (regarding temperature, precipitation, and wind) that are especially caused by human activities, (Youmatter, 2020). Climate change refers to significant changes in global temperature, precipitation, wind patterns and other measures of climate that occur over several decades or longer. Evidence suggests many of these extreme climate changes are connected to rising levels of carbon dioxide and other greenhouse gases in the Earth's atmosphere — more often than not, the result of human activities. Climate change can be a natural process where temperature, rainfall, wind and other elements vary over decades or more. In millions of years, our world has been warmer and colder than it is now. But today we are experiencing rapid warming from human activities, primarily due to burning fossil fuels that generate greenhouse gas emissions.

### **The Implications of Climate Change on Buildings**

When climatic conditions exceed normal parameters, it directly impacts the structure of the building. Climate change will breed conditions where these parameters are exceeded more often and to a far greater degree. What was previously considered a once-a-century flood may become a regular occurrence. The impacts are certainly more drastic. As is already evident, heat waves are more severe now, affecting building structures. Frequently occurring floods are wiping away entire dwellings with them.

Clearly, the built environment and its infrastructures will be greatly affected by climate change through higher temperatures, erratic and variable precipitation, rises in sea levels, and wind actions, which have impacts on the surface of the environment and also varying impacts on the built environment (Milly et al., 2002; Meehl and Tebaldi, 2004; UKCIP, 2005; Emmanuel, 2005; Robert, 2008; Kummert and Robert, 2012). These activities from the changing climate are observed to be increasing in frequency and magnitude (Mizra, 2003; Boko et al., 2007).

Some effects may be controllable, but the insidious effects of climate change can gradually undermine the core functions of a building.

- **Increased energy demand:** Rising temperatures can lead to increased cooling needs in buildings, especially in regions with hotter climates. Buildings may require more energy for air conditioning, which can strain electrical grids and increase greenhouse gas emissions if the energy is generated from fossil fuels.
- **Extreme weather events:** Climate change is associated with an increase in extreme weather events such as hurricanes, floods, and wildfires. Buildings need to be designed and constructed to withstand these events, using materials and techniques that can resist strong winds, heavy rain, or intense heat.
- **Changing precipitation patterns:** Climate change can alter precipitation patterns, leading to more frequent and intense rainfall in some areas and drought conditions in others. Buildings need to incorporate effective drainage systems to manage increased water runoff and potential flooding risks. Additionally, water conservation measures may be necessary in areas experiencing water scarcity.
- **Rising sea levels:** As global temperatures increase, melting glaciers and thermal expansion of seawater contribute to rising sea levels. This poses a significant threat to coastal buildings and infrastructure. Adaptation measures such as elevating buildings, constructing sea walls, or relocating infrastructure may be necessary in vulnerable areas.
- **Material selection and durability:** Climate change can impact the durability and lifespan of building materials. Increased heat, moisture, and exposure to extreme weather conditions can accelerate the deterioration of certain materials, such as wood, and increase maintenance

requirements. Builders need to consider climate resilience and select materials that can withstand the local climate conditions.

- **Indoor environmental quality:** Climate change can affect indoor environmental quality in buildings. Increased temperatures and humidity can impact occupant comfort, health, and productivity. Adequate ventilation, thermal insulation, and efficient HVAC systems become crucial to maintain comfortable indoor environments.
- **Renewable energy integration:** Climate change mitigation efforts require a shift towards renewable energy sources. Buildings can play a vital role in this transition by integrating renewable energy technologies such as solar panels, wind turbines, or geothermal systems. This reduces reliance on fossil fuels and helps reduce greenhouse gas emissions.
- **Building codes and regulations:** Climate change adaptation and mitigation strategies necessitate updates to building codes and regulations. New standards may be developed to ensure buildings are resilient, energy-efficient, and equipped to withstand changing climate conditions. Governments and regulatory bodies play a critical role in implementing these changes.

### **Economic Impacts of Climate Change in Nigeria**

Nigeria has not escaped the negative impact of this horrendous environmental change. The country is practically under siege as most cities are either engulfed by raging floods or confronting surging desertification. From East to West, North to south, erosion and desert have continued to eat the land. All these are crippling the people and the national economy, and it seems the country is helpless. Often, environmental hazards disrupt economic activities in addition to the massive displacement of people. The people of Abeokuta, Ibadan, Ode Remo, to mention but a few, hardly escape the agony of flooding every rainy season. According to a recent report by Tell magazine, incessant flooding has turned most economically buoyant communities in Lagos State into deserts of sorts. This is not limited to Lagos or even the southwest. Indeed, in many communities across Nigeria, "tales of woes and pains usually follow any down pour."<sup>31</sup> While most residents are usually displaced, their economies are also dislocated. In Lagos, industrialized and commercialized areas like Victoria Island and Ikeja usually encounter floods, resulting in the loss of valuable goods.<sup>32</sup> The floods have also resulted in erosion and landslides in many parts of the country. In fact, most communities in South-eastern Nigeria are practically living in the "shadow of death" due to the effects of erosion and landslides. According to the Tell magazine, "the southeast has the highest number of erosion sites, with the majority in Anambra State (62 critical and 550 active). The latest landslide in Nanka community literally cut off the community from the rest of Anambra State, halting all economic activities. Other areas affected include Ozubulu, Onitsha, Ukpor, Agulu, Aguleri, and Amakpo, among others. If Southern Nigeria is under the surging siege of downpours, the northern part is perpetually confronting the ravaging desert. Experts are warning that "the biological potential of land to grow plants in 10 northern States of the country is diminishing at an alarming rate. This phenomenon actually portends hardship and economic doom for a region with over 20% of its population dependent on farming and animal husbandry. Unfortunately, doomsday is already here, as statistics show that Nigerians are already suffering the economic impact of desertification. The country has already lost about 350,000 hectares of arable land to desertification each year; many families are forced to abandon their land due to barrenness; and almost 35 million people have already been affected. For example, about 50,000 farmers in 100 villages have been affected in Yobe State, and 40,000 farmers in Borno State have lost their means of livelihood due to desert encroachment. As a recent survey suggests, the impact is likely to spread further as the Sahara Desert is advancing southward at a rate of 0.6 kilometers per year.

There is a general consensus that desertification is by far the most pressing environmental problem in the dry lands parts of the country. Nigeria loses over 350,000 ha annually to advancing desert, leading to the deterioration of ecosystems, degradation of various forms of vegetation, destruction of biological potential, diminution of biological potential, decay of

a productive ecosystem, and reduction of productivity. Nigeria is also losing the capacity to feed its population.

### **Strategies to Mitigate Climate Change Impacts on Buildings**

Mitigating the impact of climate change on buildings requires a combination of strategies that focus on energy efficiency, renewable energy adoption, sustainable materials, and resilient design. Here are some key strategies with references to support them:

**1. Energy-efficient building design:** Improve insulation, air sealing, and windows to reduce heating and cooling energy demands. Use energy modeling tools to optimize designs. Incorporate passive design principles, such as natural ventilation and daylighting, to reduce the need for artificial lighting and mechanical cooling. Utilize efficient HVAC systems, including high-efficiency equipment, heat recovery, and smart controls United Nations Environment Programme (UNEP, 2021).

**2. Renewable energy integration:** Install on-site renewable energy systems, such as solar panels or wind turbines, to generate clean electricity for the building's operations. Explore opportunities for community-scale renewable energy projects or district energy systems that serve multiple buildings.

**3. Sustainable materials and construction:** Use low-carbon building materials, such as recycled content, sustainably sourced wood, or materials with lower embodied carbon. Opt for sustainable construction practices that minimize waste generation and promote recycling or reusing of materials.

**4. Water management and conservation:** Implement water-efficient fixtures and appliances, such as low-flow toilets and faucets, and utilize rainwater harvesting systems for non-potable water uses (EPA, 2017). Design landscapes that require minimal irrigation and incorporate green infrastructure elements like rain gardens or bios wales to manage storm water.

**5. Resilient design and adaptation:** Consider climate resilience in the building design by accounting for future climate projections, such as increased temperatures, extreme weather events, and sea-level rise. Implement measures to enhance building resilience, such as elevating structures, incorporating flood-resistant materials, or installing backup power systems.

### **Conclusion**

The study concludes that the issue of climate change and building sustainability has significant implications for the environment, society, and the economy. Nigeria, like any other country is experiencing the adverse effects of climate change, including increased temperatures, extreme weather events, and rising sea levels. These impacts pose a threat to human health, livelihoods, and infrastructure. Addressing climate change through building sustainability in Nigeria requires a multi-faceted approach involving awareness, policy, finance, collaboration, research, and community engagement. By taking the strategies mentioned in this work, Nigeria can enhance its resilience to climate change, reduce greenhouse gas emissions, and create sustainable and livable cities for future generations.

### **Recommendations**

1. There is a need for increased awareness and education about the importance of sustainable buildings and their roles in climate change mitigation and adaptation. This can be done through public campaigns, training programs, and educational initiatives targeting architects, engineers, policymakers, and the general public.
2. The Nigerian government should develop and enforce comprehensive policies and regulations that promote sustainable building practices. This includes incorporating green building standards, energy efficiency requirements, and renewable energy integration into building codes and planning frameworks.

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