



ABSTRACT

Urban resilience refers to the capacity of a city to recover from disasters or climate change by adapting to emerging challenges while ensuring sustainable development. This article provides an overview of urban resilience to climate change in Nigeria, with a focus on its impacts and the adaptation strategies adopted in urban areas. Cities around the world particularly in developing countries are increasingly confronted with challenges to socio-economic development caused by climate

BUILDING URBAN RESILIENCE FOR CLIMATE CHANGE: A REVIEW OF ADAPTATION STRATEGIES

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Introduction

Urban areas around the world are experiencing more severe impacts of climate change compared to rural areas. According to Butu et al. (2022), the country is currently grappling with a range of complex, direct, and indirect consequences of climate change, including food insecurity, forced displacement, conflict, and adverse health outcomes. These challenges collectively pose significant barriers to climate action and economic development. The heightened vulnerability of urban areas stems from their complexity, where critical assets such as hospitals, offices, schools, and other infrastructure are densely concentrated. This spatial concentration, coupled with high population density, amplifies the impacts of extreme weather events such as storms, floods, and disease outbreaks. Therefore, a comprehensive understanding of climate change impacts, alongside the implementation of effective adaptation and



change. Consequently, the need to safeguard urban areas against these impacts has become critically important. This article examines the environmental impacts of climate change in Nigeria's urban areas. These impacts include altered rainfall patterns, rising temperatures, food insecurity, reduced agricultural productivity, health challenges, and biodiversity loss. The paper also analyzes a range of adaptation strategies employed by cities to strengthen their resilience to changing climatic conditions. These strategies include, but are not limited to, the implementation of green and blue infrastructure such as urban forests and water management systems to mitigate the effects of extreme weather events like floods and heatwaves.

Keywords: Climate change, urban resilience, food security, adaptation strategies, biodiversity, environmental impact.

mitigation strategies, is crucial for achieving sustainable development.

Climate change refers to long-term shifts in weather patterns and average global temperatures. It is primarily driven by human activities, including but not limited to the burning of fossil fuels (such as coal, oil, and gas), deforestation, industrial operations, and agricultural practices. These activities release significant amounts of greenhouse gases such as carbon dioxide, methane, and nitrous oxide into the atmosphere, thereby intensifying the greenhouse effect. In Nigeria, climate change has manifested through recurrent floods (both riverine and urban) and other related disasters, which have contributed to a rise in disease incidence, particularly vector-borne diseases like malaria. In 2021 alone, malaria accounted for approximately 200,000 deaths in Nigeria, representing 32% of the global malaria mortality, and affected around 60 million people (WHO, 2022, as cited in Butu et al., 2022). Climate change presents significant threats to urban environments, including rising temperatures, heat stress, water scarcity or extreme precipitation, inland and coastal flooding and rising sea levels.

Urban resilience to climate change has become an essential component of contemporary urban development, driven by the increasing intensity and frequency of climate related impacts on urban environments (Vimawala, 2021 cited in Ilugbusi et al., 2024). A resilient city is one that actively assesses risks, plans, and takes action to prepare for and respond to both expected and unforeseen hazards. Resilient cities possess the capacity to absorb, recover from, and prepare for future shocks whether environmental, economic, social, or institutional while promoting sustainable development, prosperity, and inclusive growth (Ayadu & Idibeke, 2021). Urban resilience is thus a dynamic, multidimensional process involving diverse stakeholders,



aimed at enhancing the urban environment's ability to withstand and recover from both external and internal disturbances. It is a critical framework for addressing the growing challenges that cities face in the context of environmental change.

Recognizing the urgency and complexity of climate change, cities and stakeholders are increasingly adopting strategies to adapt to and mitigate its impacts. These efforts are vital for strengthening climate resilience and advancing sustainable development, particularly in urban areas of Nigeria. The integration of resilience thinking has proven instrumental in managing unexpected climate events and reinforcing efforts to withstand and adapt to their consequences. For instance, Nigeria has concentrated efforts on reducing greenhouse gas emissions, especially from the oil and gas sector, which is a major source of the country's emissions (Ekhuemelo & Adole, 2024). In light of these challenges and efforts, this paper aims to examine the various factors that enhance urban resilience and provides a comprehensive analysis of the adaptation strategies adopted by urban communities to address climate change impacts.

Impacts of climate change in Nigeria

Climate change refers to the long-term shifts in weather patterns and average global temperatures. Climate change significantly impacts livelihoods, ecosystems and the socio-economic activities, thereby shaping the trajectory of human well-being. This climate change is driven by human activities such as the burning of fossil fuels such as coal, oil, and gas, deforestation and agricultural practices. These activities release greenhouse gases such as carbon dioxide, methane, and nitrous-oxide into the atmosphere. These gases trap heat from the sun, resulting in a gradual rise in global temperatures and alterations in climate patterns.

- **Erratic rainfall patterns:** Climate change has significantly disrupted rainfall patterns in Nigeria, resulting in both prolonged droughts and episodes of intense rainfall and flooding across different regions of the country. Flooding, often classified as a disaster event, occurs when areas that are typically dry become submerged due to the overflow of water caused by extreme or excessive rainfall. These climate induced events pose serious challenges to agricultural productivity, potentially leading to food insecurity, as well as placing strain on water resources and critical infrastructure.
- **Increased Temperatures:** Climate change in Nigeria is contributing to rising temperatures and more frequent, severe heat waves. Urban areas, which are already affected by the urban heat island effect, are especially vulnerable and are likely to experience the most intense impacts of these extreme heat events. The increase in urban temperatures poses serious risks to human health, particularly among vulnerable populations such as the elderly, children, and those with pre-existing health conditions. Additionally, extreme heat reduces agricultural productivity and exacerbates water scarcity in



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several regions of the country, further intensifying socio-economic vulnerabilities.

- **Coastal erosion and sea-level rise:** Coastal areas are vital to Nigeria's sustainable economic development and the livelihoods of many communities. However, climate change is expected to intensify the challenges facing these regions, increasing the risks of coastal erosion, flooding from sea-level rise, and saltwater intrusion into freshwater sources. These impacts threaten communities, infrastructure, and local economies. According to Ola (2022), climate change is altering the nature and characteristics of freshwater resources, upon which many Nigerians rely. Rising sea levels and extreme weather events negatively affect fishing activities and disrupt livelihoods. Additionally, coastal erosion and sea-level rise can damage critical infrastructure such as roads, bridges, and buildings, resulting in costly repairs and maintenance.
- **Reduction in agricultural productivity and food security:** Climate change has significant effects on agriculture and food production, primarily due to agriculture's heavy dependence on rainfall. It impacts food production both directly through changes in agro-ecological conditions and indirectly, by influencing income distribution and thereby affecting the demand for agricultural products. Climate change further exacerbates the vulnerability of farmers, fishers, and communities that are depending on forest, making them more food insecure and worsening their living conditions. Climate change is expected to intensify the vulnerabilities of livestock systems, further threatening food security. Climate change poses threats to food availability by affecting crop production and livestock due to increased flooding, droughts, shifts in rainfall patterns temperatures and other climatic related changes.
- **Health:** Climate change, both directly and indirectly, is expected to exacerbate health challenges in Nigeria, particularly for those living below the poverty line, who may struggle to access adequate public health facilities. According to the World Health Organization (WHO, 2013), Nigeria currently faces a high burden of health issues, the scope and geographic distribution of which could be further impacted by changing temperature and precipitation patterns. These health challenges include malnutrition, diarrheal diseases, malaria, and other vector-borne diseases, with women and children being the most vulnerable. Some of these health problems may be attributed to climate change, while others result from factors such as food insecurity, poor governance, inadequate environmental sanitation, limited public health infrastructure, insufficient healthcare personnel, and financial shortages.
- **Loss of Biodiversity:** Biodiversity is crucial for the health and survival of the planet. However, the impacts of climate change are becoming increasingly



evident. Rising temperatures, changes in the patterns of precipitation and extreme weather events are threatening the survival of various plant and animal species, potentially leading to local extinctions. This is one of the most concerning effects of climate change, as it results in the destruction of habitats. However, the impacts of biodiversity loss are not uniform across the globe; some regions and species are more vulnerable than others. The loss of species can trigger ecosystem collapse, weakening ecosystems' ability to withstand and recover from disturbances such as climate change. This, in turn, can have far-reaching consequences on food security and water quality.

- **Urbanization:** Environmental changes, particularly those driven by climate change, often trigger migration from rural to urban areas. For instance, flooding caused by climate change in coastal regions of Nigeria has forced many people to relocate to urban and semi-urban areas. This migration can have significant impacts on both urban and rural economies, potentially leading to increased pressure on urban infrastructure and resources. Additionally, the movement of people from rural areas can exacerbate food insecurity, as agricultural productivity in rural regions declines, while urban areas may struggle to accommodate the growing population.

Adaptation and mitigation strategies for urban resilience to climate change

Understanding adaptation and mitigation strategies for climate change is crucial for developing and implementing effective measures that enhance adaptive capacity and resilience, reducing vulnerability for individuals, communities, and ecosystems. Adaptation refers to the adjustments made in ecological, social or economic systems in response to actual or anticipated climatic stimuli and their impacts. Climate change adaptation aims to reduce vulnerability and strengthen resilience to climate change impacts (Hakwendenda, 2022). Ultimately, adaptation seeks to reduce the vulnerability of both natural and human systems to climate change. This involves prioritizing long-term human well-being and equity, fostering capacity-building within communities, and implementing policies that reduce vulnerability through a co-creative process involving various stakeholders.

- **Integrating Green and Blue infrastructure:** Urban blue-green infrastructure (BGI) refers to nature-based features integrated into built-up areas that form part of the urban landscape, providing a range of environmental, social, and economic benefits. These features can be based on vegetation (green), water (blue), or both. Examples include green roofs and walls, grassed areas, rain gardens, trees, parks, rivers, and ponds. Parks, playing fields, and other open spaces should be incorporated into strategic plans as critical components of green and blue infrastructure. Green infrastructure mitigates heat by promoting evapotranspiration, reflecting solar radiation, reducing heat



storage, providing shade, and encouraging air circulation, which helps dissipate heat.

To improve the quality and accessibility of green spaces, BGI can deliver multifunctional benefits such as flood mitigation, cooling, air quality improvement, biodiversity enhancement, habitat creation, and urban agriculture spaces. Thus, in the context of Nigerian urban areas, blue-green infrastructure is essential as both a climate change adaptation and mitigation measure, offering numerous advantages for people and wildlife. Coordination between green spaces, water systems, and built infrastructure can prevent natural disasters, build resilience, and foster climate change mitigation and environmental sustainability. Furthermore, BGI can enhance air and water quality, improve carbon storage, regulate temperatures and floods, reduce noise, and boost resource efficiency, biodiversity (Maksimovic, 2017).

- **Early warning systems and disaster preparedness:** Early warning systems (EWS) play a critical role in providing advance notice of hazardous weather conditions, such as floods, storms, and droughts, allowing communities to take preventive measures, reduce risks, save lives and properties. Establishing EWS and preparedness for extreme weather events will help mitigate any negative impacts of climate change. Without clear guidance, communities may lack the resources or knowledge to respond adequately to threats, increasing the risk of loss of life, economic disruption, and damage to infrastructure. Therefore, it is essential that EWS is effective.
- **Implementing urban ventilation strategies:** Implementing urban strategies that harness prevailing breezes can significantly improve air quality and mitigate the urban heat island (UHI) effect. Wind plays a vital role in regulating urban temperatures, enhancing evaporative cooling, and promoting plant transpiration, making it a key factor in district-wide passive cooling strategies. At the microclimatic level, strategically designed urban environments can take advantage of natural airflow to reduce reliance on energy-intensive cooling systems and create more comfortable outdoor and indoor conditions.
- **Livelihood Diversification:** The impacts of climate change on agricultural productivity, food security, and the livelihoods of urban dwellers can be severe, particularly in regions like Nigeria where climate events such as floods and droughts are becoming more frequent and intense. Livelihood diversification emerges as a strategy for coping with the climate change. By diversifying their sources of income, individuals and communities can build resilience, reduce vulnerability, and improve food security. For instance, livelihood diversification can serve as an effective adaptation strategy to flooding, as people may shift to alternative income generating activities that are less dependent on climate sensitive sectors such as agriculture. Insurance



schemes can as well provide financial support to rebuild livelihoods after extreme climatic events, helping communities recover faster. Moreover, alternative livelihoods such as small-scale businesses can help buffer against the economic loss caused by unpredictable weather patterns.

- **Public awareness and education:** Raising climate change awareness through education and outreach empowers individuals, communities, and organisations about the impacts, risks and vulnerabilities of climate change to understand the urgency and necessity of taking action in adopting sustainable practices and supporting mitigation efforts.
- **Engaging Community Participation in decision-making:** Engaging communities in the decision-making process is crucial for building adaptive capacity. Cities are fostering community engagement through participatory planning processes, community workshops, and citizen science initiatives. Capacity building involves equipping communities with the knowledge and skills necessary to adapt to and mitigate the impacts of climate change. This includes educational programs, training sessions, and awareness campaigns. By enhancing the capacity of residents to understand and respond to climate-related challenges, cities empower their communities to actively contribute to resilience efforts. Engaged communities are more likely to support and actively participate in resilience-building efforts, creating a sense of shared responsibility (Ilugbusi, et al., 2024).
- **Afforestation and Forest conservation:** Protecting existing forests and implementing effective afforestation policies are essential strategies for climate change mitigation. Urban forests offer natural shade, reduce surface and air temperatures, and alleviate the urban heat island effect. By intercepting rainfall, they also contribute to storm water management and reduce the risk of urban flooding. Moreover, urban forests improve air quality by filtering pollutants and enhancing oxygen production, thereby contributing to public health and overall urban well-being (Ilugbusi et al., 2024). Conservation through reforestation, afforestation, or the protection of existing forested areas enhances the resilience of both natural and human systems to the impacts of climate change. Such initiatives help maintain ecosystem integrity, support livelihoods and foster environmental sustainability.
- **Climate change funding:** Although there remains uncertainty about the exact cost of climate adaptation and there is no doubt that the scale of finance required is substantial. Nigeria, like many other developing nations, faces an enormous financial challenge in addressing climate change impacts and strengthening its adaptive capacity. Adewale et al. (2019) emphasize, climate adaptation must be supported by sustained, targeted financial investments to



ensure that individuals and communities possess the resources, infrastructure, and knowledge needed to respond effectively to the changing climate. Significant investments are needed across various sectors, particularly in the development of resilient infrastructure capable of withstanding extreme weather events such as floods, droughts, and heat waves; financial resources are needed in building capacity to empower local communities, institutions, and policymakers with the knowledge and tools necessary to implement effective adaptation strategies. Importantly, these financial efforts must prioritize regions and communities that are most vulnerable to climate change impacts, those that are socioeconomically located in high risk areas.

Conclusion

The study highlights the severe impacts of climate change on urban areas, particularly in Nigeria, where cities are increasingly vulnerable to challenges such as food insecurity, displacement, conflict, and public health issues. Due to their high population densities and concentrated infrastructure, urban environments are especially susceptible to the adverse effects of climate change, including storms, floods, and disease outbreaks. The study identifies specific climate related impacts such as erratic rainfall patterns, rising temperatures, coastal erosion, declining agricultural productivity, health challenges, and the loss of biodiversity. The study also emphasizes the socio-economic consequences, particularly in rural areas where agriculture is predominant livelihood, leading to rural-urban migration and deepening poverty.

In response to these challenges, the concept of urban resilience is presented as a critical framework for both adapting to and mitigating the effects of climate change. Urban resilience refers to the ability of cities to absorb, recover, and prepare for future climate related shock. Building urban resilience in Nigeria requires coordinated efforts across all levels of government and stakeholders' involvement. These strategies include EWS, enhancing disaster preparedness, integrating green and blue infrastructure, diversifying livelihoods, promoting public awareness and community participation, encouraging afforestation initiatives. These approaches aim to reduce vulnerability, strengthen adaptive capacity, and support sustainable urban development. Furthermore, securing sufficient climate change funding at both regional and national levels is essential to the successful implementation of these resilience building strategies.

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