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RESEARCH ARTICLE

Climate Change Adaptation and Mitigation in Land Management and Sustainability: Strategies, Challenges and Opportunities

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ABSTRACT

As climate change creates consequences, ravaging parts of Africa in somewhat irreversible ways, countries across the world continue to initiate and adopt strategies to combat the menace. Today, ecosystems and socioeconomic conditions are being impacted in ways that heighten the pressure and challenges on land use. These challenges have both short- and long-term impacts requiring a holistic approach for mitigating them. Using the purposive sampling technique, data was collected from 29 respondents drawn from Nigeria, the United Kingdom and the United Arab Emirates to compare perceptions on land use in underdeveloped, developing and developed communities. Secondary data published online from different countries was randomly selected from different regions of Africa south of the Sahara. The qualitative data was taken from randomly selected African countries, including South Africa, Ethiopia, Kenya, Nigeria and Niger. This study explores the strategies, challenges and opportunities faced in integrating climate change adaptation and mitigation into land management sustainability in parts of Africa, as well as the opportunities that can be leveraged locally through indigenous cultural knowledge. The study offers valuable insights for policymakers, practitioners and stakeholders on the integration of climate change adaptation and mitigation into land management.

Keywords: Climate Change, Mitigation, Adaptation, Land Management, Strategies

1.0 Introduction

Africa has a diverse ecosystem encompassing tropical rainforest, savannas and desserts. Each of these ecosystems feature rich land resources. In recent times, however, the surge, frequency and manifestation of unusual climate change have been threatening the ecosystems and their sustainability (Shivanna, 2022). The manifestation of the impact of climate change has been recorded in different forms, including abnormal rise in temperature, desertification, flooding, drought and rainfall patterns that are unpredictable. The result is that climate change further impacts food security on the continent where the capacity to mitigate it is lacking owing to infrastructural, technological and financial constraints (Masipa, 2017). The lack of visionary leaders who can transform the respective nation states into economic hubs using the available natural resources remains a bane to the management of the impacts of climate change. With many countries already having existing policies relating to climate action, what remains is concerted efforts in driving the implementation of the frameworks to the grassroots.

Attempts to put some checks to the impact of climate change have recently revolved around adaptation and mitigation. Adaptation has to do with adjustment of the management of land and land-based agricultural practices in line with climate-change realities. Mitigation involves a deliberate attempt to minimize global warming by proactively cutting down on greenhouse gas emissions. While these strategies are considered to be effective mechanisms for maintaining land sustainability on the continents (Lawler et al., 2013), there is a need for Africa to keep pace with environmental changes precipitated by climate change. It is also necessary to devise mitigation-driven efforts meant to educate stakeholders by involving them in actions targeted at curbing practices that further deplete the ozone layer, thus leading to environmental pollution and aggravating climate change.

The implementation of these practices needs to be regulated and fortified by active policies and collaborative frameworks. It is therefore not enough for African countries merely to present themselves as signatories to global climate actions. African governments and their populace must adopt comprehensive approaches to the sustainable management of land resources, following the acquisition of sustainability literacy, especially in relation to climate action. This literacy should cover awareness on environmental factors, the socio-economic dynamics impacting land use, and the political and cultural practices relating to environmental or land sustainability.

This study explores the impediments to the incorporation of adaptation and mitigation strategies into land management and agricultural practices in Africa as it relates to changes in the global climate situation. It aims to investigate the level of literary about climate change causes, courses and consequences in Africa. It also examines the involvement of multinational institutions in global action on climate change and compliance to policies relating to the mitigation strategy, while juxtaposing these actions with the prevailing consequences of climate change across selected countries in Africa.

2.0 Theoretical Framework: Sustainability and Resilience in African Land Management

This study adopts Sustainability Theory alongside Vulnerability and Resilience Theory. The frameworks help in the elucidation of practices relating to the integration of climate-change adaptation and mitigation within parts of Africa. The essence is to project functional methods and ideas that uncover tactics that potentially foster interactions between the socioeconomic system and the environment while encouraging sustained resilience. At the core of sustainability theory is the discovery and practice of activities that propel sustained and futuristic viability in the economic, social and environmental necessities. Consequently, it is important to achieve an equilibrium in which present environmental and socioeconomic needs are met without negatively impacting the prospective needs of coming generations. Hediger (2000) suggests that efforts in the context of land management should centre on sustainable practices that balance exploitation of land resources and the conservation of land for future generations.

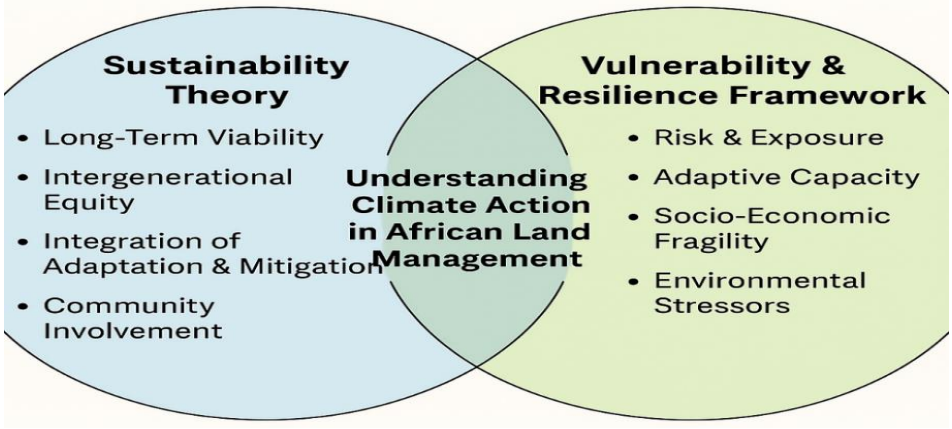

Figure 1: The combination and intersection of the research frameworks

3.0 Methodology

This study investigates current policies and land-management practices across various African regions, identifying effective strategies and highlighting innovative case studies that successfully integrate climate adaptation and mitigation. To investigate how land-management practices in Africa incorporate adaptation to climate change, this study used a survey method to gather data based on a qualitative research design. Among the data-collection techniques are document analysis of climate policies, case studies of accomplished initiatives and semi-structured interviews of various people at the community level.

4.0 Findings

Twenty-nine (29) respondents were selected using the purposive sampling technique. The respondents included marginalised populations, with females constituting 48.3% of the sample (see Figure 3).

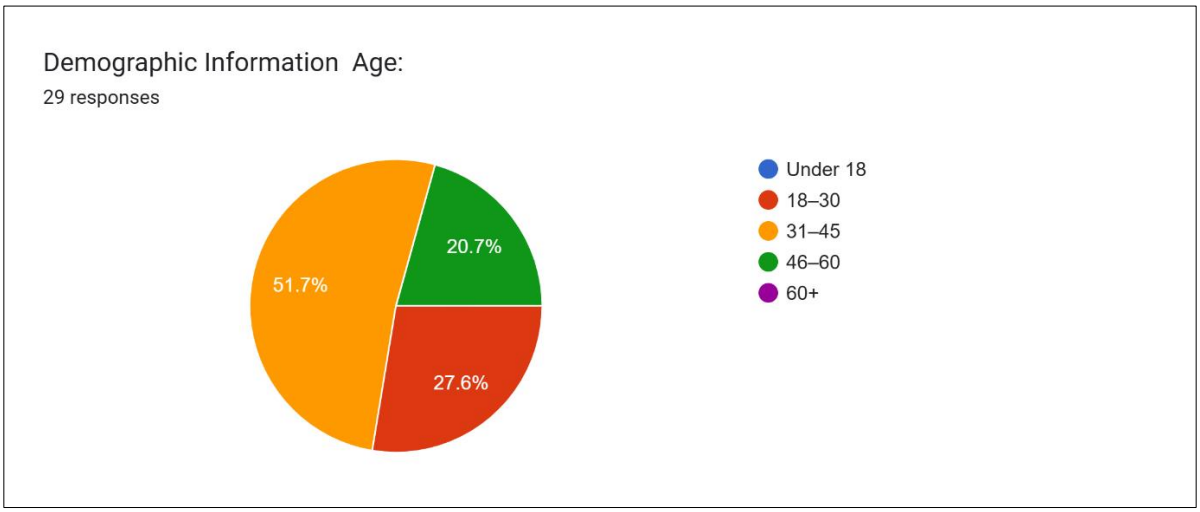

Figure 2: Demographic information on age of respondents

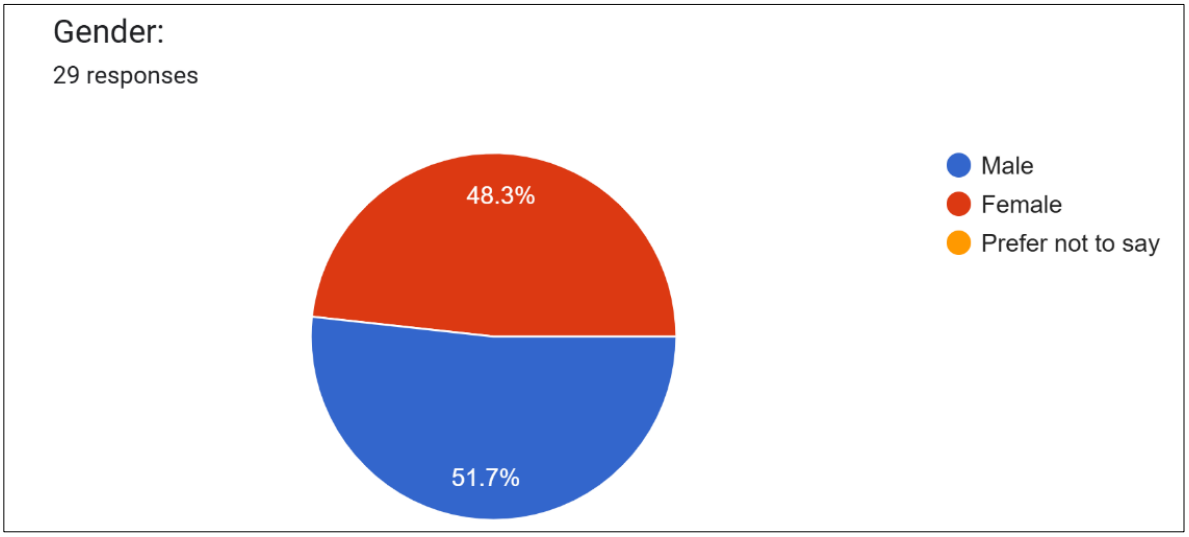

Figure 3: Showing gender disparity of respondents with males slightly more than the female respondents

To allow for a cross-comparison of perceptions on the impact of climate change on land-use practices, the respondents were carefully drawn from different communities considered to be underdeveloped, developing and developed. Thus, this sample group encompasses people residing in the United Kingdom, the United Arab Emirates, and Nigeria (see Figure 2 bar chart). Thematic analysis was used

to examine the data in order to find trends pertaining to mitigation, adaptation and land management.

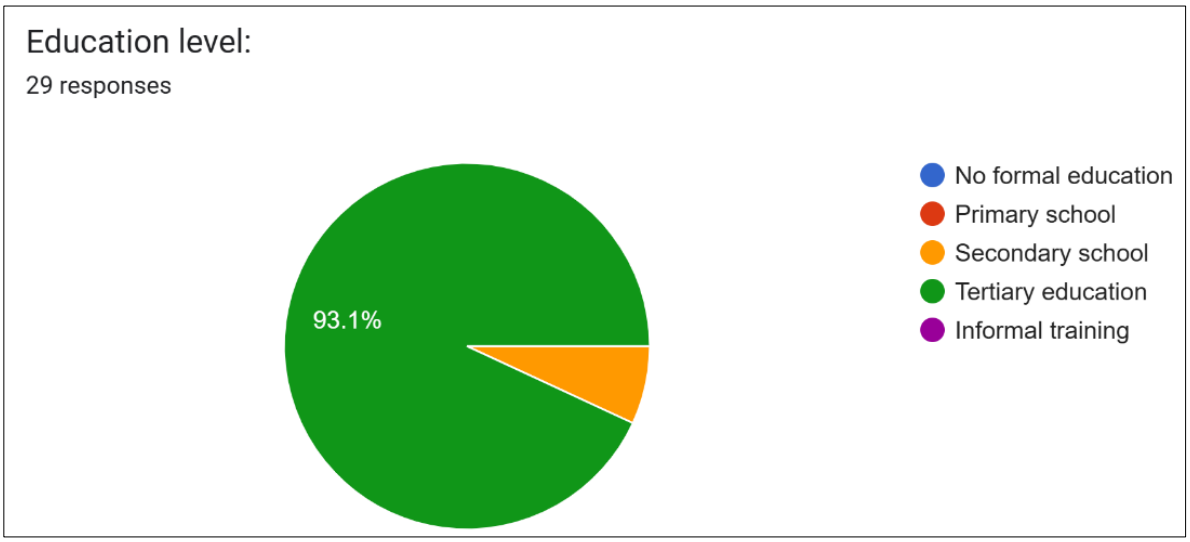

Figure 4: Education level of respondents

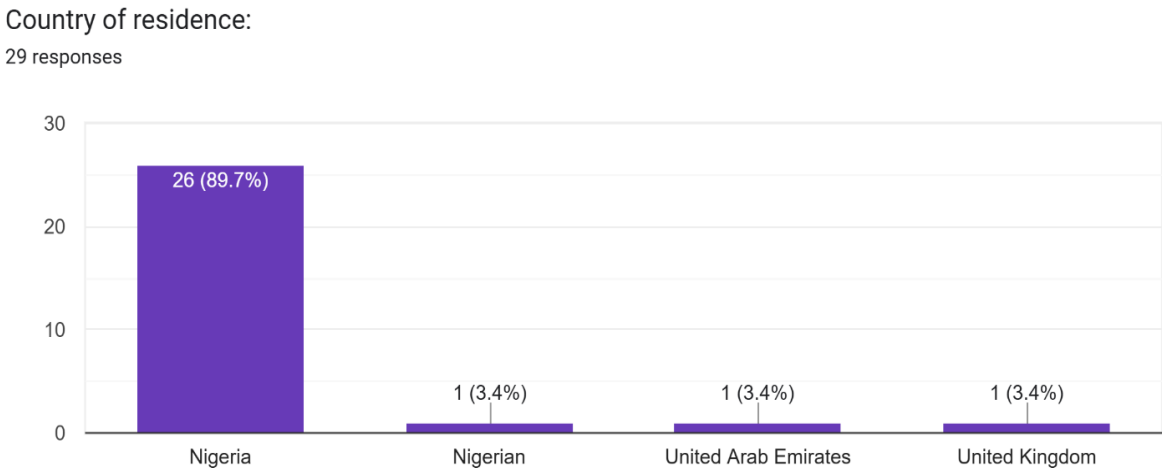

Figure 5: Showing countries from which respondents are drawn with Nigeria in the majority

The intersection of sustainability, vulnerability and resilience

In the African context, understanding the intersection of sustainability, vulnerability and resilience is crucial to forestalling unsustainable activities that plunge land resources into precarious conditions, including deforestation, land degradation, overgrazing and poor water management. Behnassi et al. (2011) assert that domesticating sustainable land management in Africa must prioritize the involvement of local socioeconomic settings owing to heavy reliance on land resources for livelihoods, particularly in rural communities. In this context, it becomes ideal to deploy the vulnerability and resilience framework, which specifically focuses on the understanding of hazards associated with climate change. The vulnerability slant in the framework primarily concerns susceptibility to harmful situations when exposed to environmental and social change in a state bereft of the capacity to adapt (Adger, 2006). Africa remains susceptible to climate change consequences because of its dependence on industries that are sensitive to climate change and its economic sectors with relatively low adaptive capacity (Boko et al., 2007). To investigate this problematic situation, the study first considers previous research on the subject.

The Vulnerability and Resilience Framework offers a more narrowed perspective to appreciating how these systems deal with particular climate-related hazards, whereas Sustainability Theory offers a comprehensive framework for addressing the long-term viability of ecosystems and civilisations. Adger (2006) defines vulnerability as "the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt." Owing to the continent's reliance on climate-sensitive industries such as agriculture, which has a comparatively low adaptive capability, Africa has been particularly vulnerable to climate change (Boko et al., 2007).

The foundation provided by the intersection of Sustainability Theory and the Vulnerability and Resilience Framework will lead to a thorough understanding of how African land management may adapt to climate change. Sustainability theory covers areas that are not commonly captured in the wellness-being theory. Among these areas are emphasizing the pivotal role of conservation of resources and the projection of intergenerational equity, which promote policies that discourage mortgaging the ecological future for relatively short-term benefits.

Sustainability theory also promotes integrated policy frameworks that are in tandem with climate mitigation and adaptation mechanisms, while also stressing the expediency of inclusive governance. On its part, the vulnerability framework considers the vulnerability of populations based on occupation and location, the capacity of such populations or communities to survive climate-induced incidents, and the mapping out of zones that are prone to climate-change risks. These frameworks combine to offer a thorough guide on how land-management policies might be tailored to minimize the short- and long-term effects of climate change in addition to promoting the sustainability of land resources.

Document Analysis: Climate Policies, Land Management Frameworks and International Agreements in Africa

The integration of climate-change adaptation and mitigation strategies into land management and sustainability practices in Africa is informed by the United Nation's SDG goal on Climate Action, which is further domesticated in national climate policies, regional frameworks and international agreements. This document examines how these components interact to support or retard the development of sustainable and climate-resilient land-management practices in different parts of the underdeveloped and developing world.

National Climate Policies in Some African States

National climate policies across Africa show varying degrees of integration of climate-change mitigation and adaptation into land management. Some countries have developed Nationally Determined Contributions (NDCs) as part of their commitments to the Paris Agreement, focusing on both climate adaptation and mitigation efforts. For example:

Kenya's Climate Change Action Plan (2018-2022) highlights climate-smart agriculture and land restoration as critical aspects of its climate adaptation plan. This plan sets out to restore 5.1 million hectares of degraded lands by 2030 through afforestation and reforestation, in alignment with the country's Vision 2030 development blueprint (Government of Kenya, 2018). In South Africa the National Climate Change Response White Paper (2011) adds land management to its adaptation strategy, focusing on reducing the vulnerability of land-based sectors, including agriculture and forestry. The country's National Development Plan (NDP) 2030 supports resilience in the land and agricultural sectors by promoting conservation agriculture, improving soil health and implementing ecosystem-based adaptation (Government of South Africa, 2011). In addition, South Africa's commitment to climate-resilient land management is further supported by the Expanded Public Works Programme (EPWP), which includes land restoration projects to combat desertification and improve agricultural productivity (EPWP, 2020).

Similarly, Ethiopia's Climate-Resilient Green Economy Strategy (2011) emphasizes land management as one of its targeted objectives to attain middle-income status by 2025 via a zero-emission development pathway. Although there is insufficient evidence to substantiate the realization of this objective fourteen years after its initiation,

Ethiopia has invested heavily in afforestation, reforestation and soil management practices, driven by its Sustainable Land Management Programme (SLMP), which aims to restore degraded landscapes and improve the livelihoods of rural communities (Government of Ethiopia, 2011).

The Nigerian government's National Climate Change Policy 2021–2030 helps the nation accomplish its objectives of significantly lowering greenhouse gas (GHG) emissions and lessening the negative socioeconomic effects of climate change. A robust socioeconomic environment that encourages sustainable growth and lowers greenhouse gas emissions is the desired medium-term result.

Seven Sections in the Policy

Section 1 provides an overview of Nigeria's climate-change situation, justification for the policy review, the strategy used, and the connection between the policy and other relevant national policies. Nigeria's susceptibility to, as well as the effects of, climate change are discussed in Section 2. Consistent with this second section, data from respondents lucidly revealed the country's vulnerabilities to climate change.

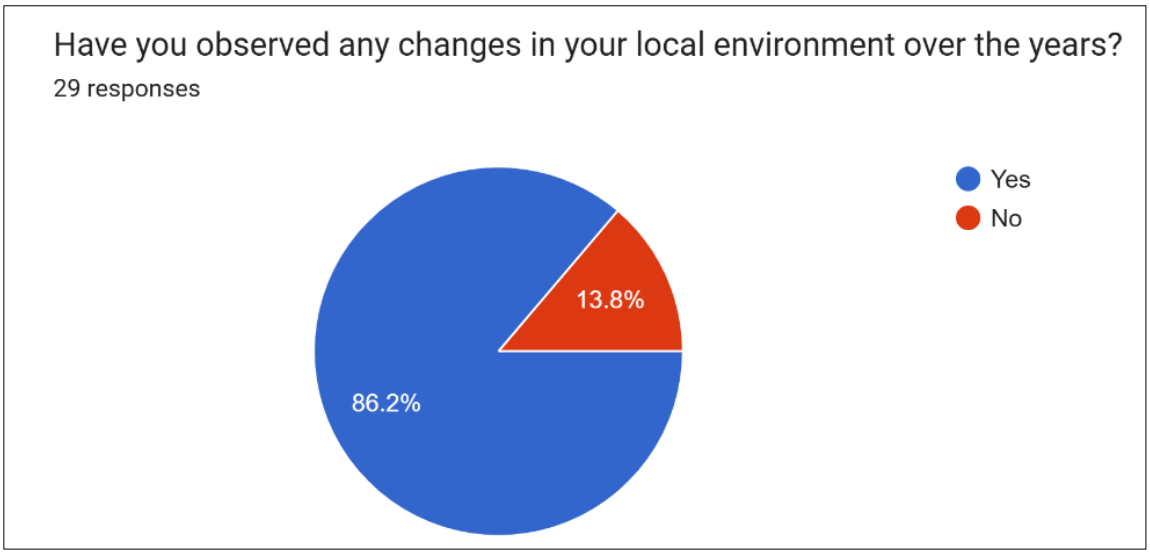

Figure 6: Chart showing most respondents have witnessed the impact of climate change in their communities

The goals, vision and guiding principles of the policy are outlined in Section 3. Section 4: Policy declarations to expedite the necessary procedure and execution of efforts to mitigate climate change. Important policy recommendations for Nigeria's adaptation to climate change are outlined in Section 5. Section 6 outlines the prerequisites for realising the goal of guaranteeing an economy that is climate-resilient. Section 7 outlines practical implementation strategies that can lead the nation towards sustainable growth that is compatible with climate change.

4.1 Discussion of Findings

This study examines the incorporation of climate-change adaptation and mitigation strategies into land-management and sustainability practices across Nigeria, Africa and a small part of the UK and the UAE. As case studies, national climate policies and land-management frameworks are explored, resulting in the emergence of notable findings.

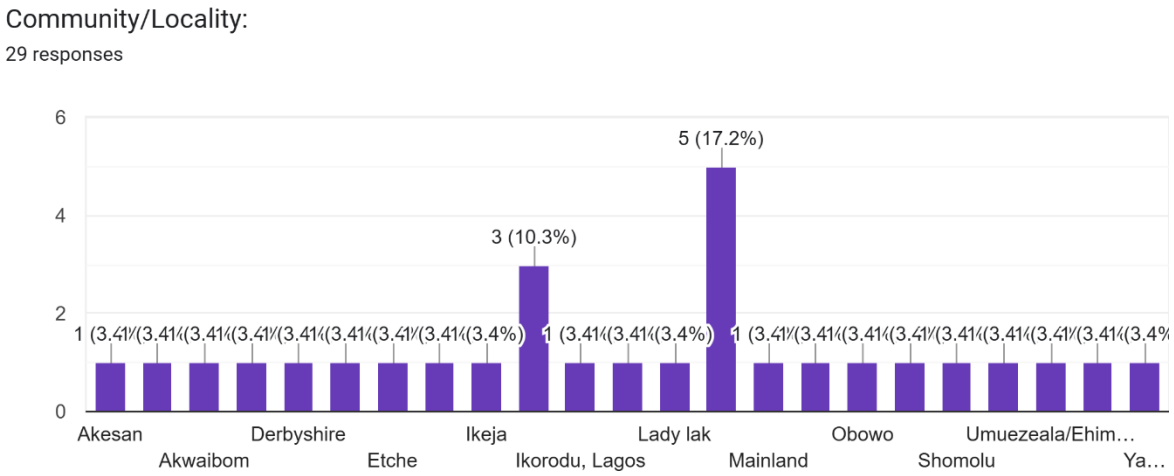

Figure 7: Bar chart showing different locations from which respondents were drawn based on the considerations of underdeveloped, developing and developed community status

Table 1: Table showing respondents' list of climate change effects in their communities

Observed Change	Frequency (Responses)
Heatwaves	2
Increased heatwaves	2
The sun is too high	2
Excessive flooding	1
Rising temperature	1
Prolonged dry season	1
Heavy rain	1
Very hot weather	1
Excessive sunlight	1
Unpredictable weather	1
Erratic rainfall	1
Global warming	1
Decreased rainfall	1
Scorching sun	1
Dry spells	1
Climate change	1
Flooding	1
Hot weather	1
Poor rainfall	2
Increased flooding	1
Hot weather and heatwaves	1
Heatwaves, increase	1
Too much rainfall	1

The responses from Nigerian respondents reflect a lived reality of climate change impacts as experienced particularly in the West African context, and also in low-lying and semi-arid zones. These observations, drawn largely from personal and communal experience, uncovers an increasing awareness of environmental instability and its immediate implications on daily life, health and livelihoods. Key reported changes include heatwaves, excessive sunlight, unpredictable rainfall, flooding, prolonged dry spells and erratic rainfall; all of which are characteristic of tropical and sub-Saharan climate variability. While some of these observations can be linked to climate change manifestations, there have been reported cases of the opening and discharge of water body from dams. Whether the people within this locations are aware or not, what is undeniable is the presence of human activities in disrupting the ecosystem and exacerbating concerns relating to eco-anxiety on land use.

However, a number of African countries have similar policies borne out of the Paris Agreement on climate action. However, regarding achieved targets, their level of compliance to policies and frameworks is still quite low. Weak institutional frameworks, constraints to funding and poor implementation constitute the rationale for not achieving the set goals, ostensibly, having a good policy is not all that is required in managing pragmatic issues relating to implementation. It is only realistic for countries to determine what works for them: mitigation or adaptation? While the relatively more developed countries in Africa, such as South Africa and Ethiopia, have adapted both strategies, the relatively lesser developed nations, including Niger and Burkina Faso, continue to rely on the strategy of adaptation The Niger case study shows how traditional methods can successfully fuse with modern adaptation strategies. The country's agroforestry, a local method, has been pivotal in the recovery of degraded land, while fostering the capture of carbon through the Managed Natural Regeneration (FMNR) initiative, which is managed by farmers. This initiative has continued to boost food security while regenerating over 5 million hectares of land. There is also a need for capacity building, as many African countries lack the human expertise to manage the challenges posed by climate change, especially in the rural areas. Building the requisite capacity presents Nigeria and the rest of Africa an opportunity to make significant contributions to efforts aimed at curbing climate change. Among the benefits from this opportunity are employment generation for local communities, restoration of agricultural lands and the assurance of food security.

Nigeria's National Climate Policy (2021-2030) has been gaining traction, following the gradual shift away from sole dependence on oil and gas for power. Solar energy and other forms of energy are being encouraged with investment in electric cars that minimize carbon monoxide emissions. It is expedient for Nigeria to explore other areas such as fossil fuels as part of the strategies for achieving its climate goals (Adeleke, 2019). However, beyond policies encouraging climate-smart agriculture, the country also faces the grave issue of acute insecurity across its regions, leading to food insecurity and an undermining of the gains of improved land-management practices.

Evaluation of the National Climate Change Policy for Nigeria (2021-2030)

The National Climate Change Policy for Nigeria (2021-2030) is a strategic framework aimed at combating the impact of climate change while fostering sustainable development and minimising greenhouse gas (GHG) emissions. There are several Implications of the policy for Nigeria's socioeconomic environment, particularly with regard to its alignment with global climate goals and the potential challenges of achieving climate resilience. The Nigerian eco-system is susceptible to the effects of climate change, including rising temperatures, changing rainfall patterns and extreme weather situations such as floods and droughts. Section 5 of the policy emphasizes adaptation measures, aiming to create a resilient socioeconomic environment. Okon et al. (2021) assert that climate-smart agriculture and improved land-management practices are cardinal in achieving food security in Nigeria, where terrorism, drought and desertification have worsened poverty and displacement.

One of the strengths of Nigeria's climate policy is its integrated approach to coordinating climate-change initiatives across various sectors, as outlined

in Section 7. The policy provides a mechanism for aligning climate action with national development planning, including the Economic Recovery and Growth Plan (ERGP) and the National Renewable Energy and Energy Efficiency Policy (NREEEP). This integrated approach is crucial for ensuring that climate action does not impede economic progress but instead supports a sustainable development trajectory. Robinson and Herbert (2001) argue that a well-managed climate policy promotes synergies between climate mitigation and development goals, doing so in ways that reduce poverty and enhance health outcomes. For example, by improving energy access through renewable energy solutions, the policy could improve the livelihoods of millions of Nigerians, particularly in off-grid rural areas (Nwazor et al., 2025). In addition, many governmental institutions lack the technology, resources and the skilled personnel to implement complex climate policies. As Nwafor et al. (2021) note, bridging this gap would expediently require the building of skilled labour in the area of climate change. Therefore, it is necessary to make capacity-building efforts and to increase investment in human resources to ensure effective policy implementation at all levels of government.

Figure 8: Picture showing flooding that displaced over 1 million people in Central Africa

Source: *New York Times*

5.0 Conclusion and Recommendation

In Nigeria and other parts of Africa south of the Sahara, the integration of climate-change strategies is an ongoing effort. Most African countries are bedevilled by the lack of expertise, capacity and fund to manage the challenges posed by climate change on land use. African countries have established programmes to address various unsustainable environmental problems, which have not been quite successfully implemented. However, these challenges present opportunities for developing expertise in the area of climate-change management in relation to land-use practices and environmental sustainability. Thus, it would be creative to include climate-change issues in the education curriculum as a way of involving the citizenry in holistic efforts to combat the catastrophic threats from climate change. The involvement of local communities, along with international support, remains instrumental to ensuring these practices are effective and sustainable.

It is therefore recommended that Africa fortify its climate policies by coordinating them with global requirements while also promoting traditional methods that work within a framework of cross-sector cooperation. Indeed, it is important to foster cross-sector synergy and open access to global finance and technology for supporting climate interventions, such as environmental restoration and renewable energy. Capacity-building programmes for communities with relatively low numbers of experts have to be prioritized to ensure that more people gain the relevant knowledge and skill-sets for managing shocks from climate-change consequences and fostering land management sustainability. Finally, it would also be necessary to keep track of the trajectory of development and accountability in climate actions, especially the monitoring and assessment systems that are in place.

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