

Recent Trends and Emerging Research in Climate Change: A Review with Focus on Nigeria and Sub-Saharan Africa

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ABSTRACT

This paper provides a comprehensive review of recent and emerging research on climate change from 2024 to 2025, with a particular emphasis on Nigeria and Sub-Saharan Africa. It highlights key global trends such as oceanic and cryospheric changes, attribution science, and emissions-related feedbacks. In the regional context, the paper delves into six major thematic areas: urban heat island effects, climate-related health risks, agricultural vulnerability, coastal degradation, climate-induced migration, and renewable energy transitions. It identifies persistent challenges such as data gaps, policy-research disconnects, and the underrepresentation of gendered and behavioral perspectives in climate studies. The review underscores the urgency for localized, interdisciplinary research and proposes actionable recommendations aimed at bridging knowledge gaps and supporting evidence-based adaptation and mitigation strategies in vulnerable regions.

Key words: Climate Change, Nigeria, Sub-Saharan Africa, Urban Heat Island, Climate-Related Health Impact, Agriculture, Food Security, Coastal Vulnerability, Climate-Induced Migration, Sustainable Energy Transitions.

INTRODUCTION

Climate change remains one of the most pressing challenges of the 21st century, affecting ecosystems, economies, and societies worldwide. Although climate change is a global phenomenon, its effects are unevenly distributed, with developing regions, particularly Sub-Saharan Africa, bearing a disproportionate share of the burden. Countries like Nigeria are especially vulnerable due to their limited adaptive capacity, infrastructural challenges, and socio-economic disparities (IPCC, 2023).

While earlier climate research focused heavily on global-scale projections and emissions pathways, recent trends reflect a shift toward more localized, actionable research that prioritizes context-specific adaptation, resilience-building, and the integration of indigenous knowledge. This review synthesizes emerging climate research over the 2024–2025 period, drawing on recent peer-reviewed studies, policy analyses, and grey literature, with a strong focus on Nigeria and the wider Sub-Saharan African context.

Global Trends in Climate Change Research (2024–2025)

Oceanic and Cryospheric Changes

A key global concern is the deterioration of ocean health due to acidification, warming, and deoxygenation. Recent reports suggest that global oceans are approaching tipping points, especially concerning coral reef collapse and marine food web disruptions (The Guardian, 2025). These trends have implications for global fisheries, climate regulation, and coastal livelihoods.

The cryosphere is also showing accelerated signs of degradation. New findings on the Atlantic Meridional Overturning Circulation (AMOC) suggest a potential collapse within the next few decades, which could

drastically alter global temperature and precipitation patterns (Carbon Brief, 2024). This would be particularly disastrous for West Africa, which depends on predictable monsoon patterns for agriculture.

Attribution of Extreme Weather Events

The field of event attribution science has matured rapidly, enabling researchers to quantitatively link individual weather events to anthropogenic climate change. For instance, the 2024 European heatwave and the 2025 South Asian floods were both confirmed to be exacerbated by human-induced warming (Earth.org, 2025). This kind of attribution not only enhances climate risk communication but also paves the way for legal accountability and insurance frameworks.

Carbon Emissions and Climate Feedbacks

Despite international pledges, global CO₂ emissions hit a record 41.2 billion tonnes in 2024, driven mainly by continued fossil fuel dependence (LiveScience, 2025). Moreover, positive feedback loops are becoming more prominent. Thawing permafrost is releasing methane, and ongoing Amazon forest degradation is undermining one of the planet's largest carbon sinks, potentially turning it into a net emitter (LiveScience, 2025).

Emerging Research Themes in Nigeria and Sub-Saharan Africa

Urban Heat Island Effects in Nigerian Cities

Rapid urbanization in Nigerian cities has led to intensified Urban Heat Island (UHI) effects. A study by Yakubu et al. (2025) on Lafia, Nasarawa State, revealed significant increases in land surface temperature due to impervious surface expansion and vegetation loss. These findings echo similar patterns in Lagos, Abuja, and Kano, where poor urban planning exacerbates heat stress, especially for low-income populations lacking access to cooling infrastructure.

Health Impacts of Climate Change

Climate change is emerging as a significant determinant of public health. Ugbomeh et al. (2025) conducted a scoping review of climate-health studies in Nigeria and found a rising incidence of heat-related illnesses, respiratory diseases due to worsening air quality, and vector-borne diseases such as malaria. However, there remains a dearth of longitudinal studies that can track exposure-response relationships across various climate-health stressors.

Agriculture, Food Security, and Climate-Smart Practices

The agriculture sector in Nigeria is highly rain-fed and thus susceptible to rainfall variability and heat extremes. Adebayo et al. (2025) report low implementation of climate-smart agriculture (CSA) practices despite moderate awareness. Barriers include inadequate farmer training, inconsistent policies, and low access to finance. Bello et al. (2025) further noted that crop yields, particularly of maize and millet, have declined due to shifting agroecological zones, thereby threatening national food security.

Coastal Vulnerability and Sea-Level Rise

Sea-level rise is an escalating concern for Nigeria's densely populated coastal zones, particularly in Lagos and the Niger Delta. Okonkwo et al. (2025) conducted perception surveys in coastal communities and found high levels of concern but limited adaptation actions due to low awareness of long-term risks and weak institutional responses. Erosion, saltwater intrusion, and displacement are becoming recurrent issues.

Climate-Induced Migration and Immobility Traps

Achebe et al. (2025) introduced the concept of "climate immobility traps" in rural Nigeria. Their household-level analysis demonstrated that vulnerable populations—particularly in flood-prone or drought-affected

zones—often lack the resources, social capital, or institutional support to migrate, thus remaining trapped in degrading environments. This challenges the common narrative that migration is always a coping mechanism.

Renewable Energy and Just Transitions

Nigeria is gradually embracing renewable energy, especially solar mini-grids in rural communities. Adeyemi et al. (2025) found that these projects improve household income, education access, and women's empowerment. However, issues related to maintenance, financing, and technical capacity threaten their sustainability. Ogunleye et al. (2025) conducted a bibliometric review and concluded that although literature on energy transitions is growing, few studies focus on community-led implementation and socio-cultural acceptability.

Cross-Cutting Issues and Research Gaps

Data Limitations

A persistent challenge in Nigerian climate research is the reliance on outdated or coarse-resolution secondary datasets. Ugbomeh et al. (2025) argue for greater investment in real-time data collection networks, including weather stations, air quality monitors, and disease surveillance systems. This would support more accurate modeling and enhance early warning systems.

Policy-Research Disconnect

Despite Nigeria's ratification of the Paris Agreement and the development of Nationally Determined Contributions (NDCs), translation into policy and action remains weak. Institutional silos, lack of knowledge brokers, and poor dissemination practices inhibit the uptake of research into policy (IPCC, 2023; Ogunleye et al., 2025).

Understudied Themes

Several important areas remain under-researched. These include:

Gender-specific vulnerabilities and adaptive capacities- Climate change is not a gender-neutral phenomenon; it affects men, women, and gender minorities differently based on social roles, economic positions, and cultural contexts. Despite the growing recognition of climate change's differentiated impacts, the intersection of gender-specific vulnerabilities and adaptive capacities remains an understudied theme in scholarly and policy discourses. A nuanced understanding of how gender shapes exposure to climate risks and the ability to respond is essential for inclusive climate resilience strategies.

Women, particularly in the Global South, often face heightened vulnerability due to limited access to resources, decision-making power, and education (Terry, 2009). In agrarian societies, for example, women are disproportionately dependent on climate-sensitive livelihoods like subsistence farming, yet they typically have less access to land rights, agricultural inputs, and climate information (Alston, 2014). These structural inequalities amplify the impact of climate-induced events such as droughts and floods.

On the other hand, women and marginalized gender groups are not merely passive victims; they also possess unique adaptive capacities rooted in indigenous knowledge systems, social networks, and caregiving roles (Arora-Jonsson, 2011). However, these capacities are often undervalued or unsupported by formal adaptation policies. Men, too, face gendered climate risks, particularly in contexts where masculinity is tied to occupational roles that are vulnerable to climate disruptions, such as fishing or pastoralism (Ravera et al., 2016).

The current climate adaptation frameworks tend to adopt a binary and overly simplistic view of gender, often treating women as a homogeneous, vulnerable group without considering intersectionalities such as class, ethnicity, and age. This limits the effectiveness of adaptation strategies and may inadvertently reinforce existing inequalities. There is a pressing need for more intersectional and gender-transformative approaches in

climate policy and research.

In conclusion, gender-specific vulnerabilities and adaptive capacities are critical yet understudied dimensions of climate change. Greater scholarly attention and policy integration of gender analysis can lead to more equitable and effective climate adaptation outcomes.

Sub-national climate finance and budgeting- Climate finance has become a central pillar in global efforts to combat and adapt to climate change. However, much of the academic and policy attention has been concentrated at the national and international levels, leaving sub-national climate finance and budgeting an understudied but critically important area. As climate impacts are inherently local, the capacity of sub-national governments to plan, allocate, and manage climate-related budgets is central to building effective and equitable climate resilience.

Sub-national governments—including cities, municipalities, and regional authorities—are at the frontline of climate impacts, such as urban heatwaves, flooding, and agricultural disruptions. Yet, they often face systemic challenges in accessing and managing climate finance due to institutional, technical, and capacity constraints (Watson et al., 2020). Limited fiscal autonomy, inadequate integration of climate objectives into local budgets, and insufficient data for climate risk assessment hinder their ability to implement locally tailored climate actions (OECD, 2019).

Moreover, sub-national budgeting processes frequently lack climate mainstreaming, meaning that climate goals are not systematically incorporated into public financial management cycles (Bird & Grantham, 2013). This disconnect undermines accountability and the efficient use of funds for climate-resilient infrastructure, disaster preparedness, and low-carbon development. Furthermore, mechanisms such as climate-tagged budgets, performance-based grants, or intergovernmental fiscal transfers conditioned on climate outcomes remain underutilized or poorly implemented at the sub-national level.

The centralization of climate finance decision-making has also led to a mismatch between available funds and local needs. Despite international efforts—such as the Green Climate Fund’s pilot programs for enhancing direct access—the flow of resources to sub-national actors remains limited (Schalatek & Nakhooda, 2013). As a result, the potential for sub-national innovation, local knowledge integration, and community engagement is constrained.

In conclusion, sub-national climate finance and budgeting represent a crucial but underexplored dimension of climate governance. Addressing this gap requires greater research, policy innovation, and financial decentralization to empower local governments as key actors in climate action.

Behavioral dimensions of climate adaptation, such as risk perception and social norms- While climate adaptation research has largely focused on infrastructural, technological, and institutional responses, the behavioral dimensions of adaptation—particularly risk perception and social norms—remain underexplored. These human factors play a critical role in shaping individual and collective adaptation decisions, yet they are often marginalized in climate policy and planning frameworks.

Risk perception influences how communities interpret and respond to climate threats. Studies show that people’s adaptation behavior is not always aligned with scientific assessments of risk, but rather influenced by subjective experiences, cultural beliefs, and trust in institutions (van Valkengoed & Steg, 2019). For instance, communities may underestimate long-term climate risks like sea-level rise if they have not experienced recent disasters, leading to inaction or maladaptation (Grothmann & Patt, 2005). Conversely, overestimation of certain hazards may result in resource misallocation.

Social norms—shared expectations within a community—also exert powerful influence over adaptation behaviors. Norms determine what is seen as appropriate or acceptable, such as whether it is normal to invest in flood insurance, migrate, or adopt water-saving practices. However, norms can either facilitate or inhibit adaptation. In agricultural communities, for example, traditional norms may discourage the adoption of new

crop varieties even when they are climate-resilient (Jones & Boyd, 2011). Behavioral adaptation is thus deeply social, not merely individual.

Despite their importance, these behavioral dimensions are often treated as secondary to economic or technical solutions. As a result, many adaptation strategies fail to account for why people do or do not take action. Integrating behavioral insights into climate adaptation policy—through risk communication, social marketing, or community-based approaches—can enhance the uptake and effectiveness of adaptive measures.

In conclusion, risk perception and social norms are fundamental yet understudied components of climate adaptation. Greater interdisciplinary research is needed to incorporate behavioral science into adaptation planning, ensuring that policies are both technically sound and socially grounded.

Mitigation of non-CO₂ greenhouse gases like methane from livestock and nitrous oxide from fertilizers-

While carbon dioxide (CO₂) has dominated climate mitigation narratives, non-CO₂ greenhouse gases—particularly methane (CH₄) from livestock and nitrous oxide (N₂O) from fertilizers—remain significantly understudied despite their substantial global warming potential. Methane is over 80 times more potent than CO₂ over a 20-year time frame, and nitrous oxide is nearly 300 times more potent over 100 years (IPCC, 2021). Yet, these emissions are often sidelined in both national climate strategies and global policy frameworks.

Agricultural activities are the largest anthropogenic sources of CH₄ and N₂O. Enteric fermentation in ruminants like cattle contributes around 40% of global methane emissions, while synthetic fertilizers and manure management are responsible for most nitrous oxide emissions (FAO, 2019). Despite the scale of these contributions, mitigation policies tend to prioritize energy and transportation sectors, where CO₂ dominates, over agricultural reforms that could yield significant short-term climate benefits.

Mitigating non-CO₂ gases presents unique challenges. Emissions from livestock and fertilizer use are diffuse, biologically complex, and deeply embedded in food systems, making them harder to regulate or quantify compared to fossil fuel emissions (Reisinger et al., 2021). However, viable mitigation options exist, including feed additives that reduce enteric methane, precision agriculture to optimize fertilizer application, and manure management technologies. Yet, adoption remains limited due to economic, cultural, and policy barriers.

Moreover, many countries do not include CH₄ and N₂O mitigation in their Nationally Determined Contributions (NDCs) under the Paris Agreement, reflecting a lack of political prioritization. This underrepresentation limits the global potential for rapid warming reduction, particularly as methane mitigation offers near-term climate benefits due to its short atmospheric lifespan.

In conclusion, the mitigation of non-CO₂ greenhouse gases, particularly methane and nitrous oxide from agriculture, remains an underexplored but crucial area of climate action. Scaling up attention, research, and policy integration is essential for achieving both near- and long-term climate goals.

Conceptual Framework: Linking Research Gaps and Future Directions

S/N	Research Gap	Description	Implications	Proposed Future Directions
1	Data Limitations	Outdated or sparse datasets hinder climate analysis.	Weak early warning systems and evidence gaps.	Build national data networks; integrate AI and remote sensing.
2	Policy–Research Disconnect	Poor uptake of research into policy.	Ineffective adaptation programs.	Establish co-production platforms between researchers and policymakers.
3	Gender Inequality	Limited integration of intersectional	Exclusion of women and marginalized	Develop gender-transformative climate programs.

		gender analysis.	groups.	
4	Sub-National Climate Finance	Weak fiscal autonomy and capacity at local levels.	Inequitable and fragmented adaptation responses.	Mainstream climate tagging; build local financial capacity.
5	Behavioral Adaptation Gaps	Risk perception and norms ignored in planning.	Low adoption of adaptation measures.	Use behavioral science for risk communication and community mobilization.
6	Non-CO ₂ GHGs	Neglect of methane and nitrous oxide mitigation.	Missed short-term emission reduction opportunities.	Integrate CH ₄ and N ₂ O into national mitigation targets.

RECOMMENDATIONS FOR FUTURE RESEARCH

1. Expand Primary Data Collection: Implement nationwide environmental monitoring systems, especially in underserved and high-risk regions.
2. Promote Interdisciplinary Approaches: Integrate environmental science with behavioral economics, gender studies, public health, and urban design.
3. Bridge Research-Policy Gaps: Create multi-stakeholder platforms where academics, government officials, and communities co-design climate solutions.
4. Leverage Emerging Technologies: Employ AI for predictive modeling, drones for land-use surveys, and satellite imagery for coastal monitoring and agricultural planning.
5. Support Capacity Building: Strengthen institutional research capacity in climate modeling, climate finance tracking, and adaptation planning through regional training and collaboration.

CONCLUSION

The landscape of climate change research is rapidly evolving, becoming more nuanced, localized, and interdisciplinary. In Nigeria and the broader Sub-Saharan African region, scholars are producing important insights into how climate change intersects with urbanization, health, agriculture, and migration. However, significant work remains to be done. Data limitations, a lack of policy integration, and the exclusion of behavioral, gender, and financial perspectives hinder the development of holistic climate responses.

Future research must prioritize contextually relevant, participatory, and implementation-focused studies that can inform both local and national strategies. As climate risks intensify, the urgency for evidence-based, action-oriented research cannot be overstated.

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