

CLIMATE CHANGE IMPACTS AND ADAPTATION STRATEGIES FOR FOOD SECURITY IN NIGERIA: A FOCUS ON FLOODS AND DROUGHTS

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Abstract

Climate change presents profound challenges globally, with Nigeria particularly vulnerable to its multifaceted impacts. This review explores the effects of climate change-induced droughts and floods on food security in Nigeria, where agriculture is central to economic stability and livelihoods. It examines how extreme weather events have intensified issues related to food supply, economic resilience, and well-being, underscoring the critical need for adaptive strategies. A systematic review of 2,500 publications, following PRISMA criteria, narrowed the focus to 450 studies, with 104 high-quality studies undergoing in-depth analysis. The findings reveal a growing threat to Nigeria's food security, as frequent flooding destroys infrastructure, erodes topsoil, and reduces agricultural productivity, leading to lower food output and increased costs. Simultaneously, droughts, particularly in the semi-arid north, drastically reduce crop yields and worsen food insecurity by depleting vital water resources. These challenges disproportionately affect smallholder farmers and pastoral communities, waning poverty and hunger. The review highlights the complexity of Nigeria's food insecurity, shaped by factors such as geography, socioeconomic status, and adaptive capacity. Despite advancements in adaptation strategies, issues like fragmented policies and inadequate infrastructure continue to hinder effective responses. However, the review identifies key opportunities to enhance food security and resilience, including greater stakeholder engagement, increased investment in climate adaptation, and the use of digital technologies. By addressing these challenges and leveraging these opportunities, Nigeria can build a more resilient and sustainable food system capable of withstanding the increasing threats posed by climate change.

Keywords: Climate Change Impacts, Food Security, Floods and Droughts, Adaptation Strategies, Nigeria

1. Introduction

Climate change poses a significant threat to global food security, especially in regions where agriculture is a key livelihood (Morton, 2007; Anderson et al., 2020; Akinkuolie et al., 2024a). In Nigeria, where agriculture supports about 70% of the workforce and contributes 25% to GDP, the challenges of droughts and floods—aggravated by climate change—are becoming more severe (Adegoke et al., 2014; World Bank, 2022). These disasters greatly

impact food supply and economic stability by decreasing agricultural production (Ayanlade et al., 2017).

The relationship between climate change and food security in Nigeria is complex, involving environmental, economic, and social factors (Akinbami & Ibikunle, 2019). Food security is defined as having sufficient, safe, and nutritious food at all times (FAO, 2006). Climate change threatens this by affecting food availability, access, utilization, and stability (Adekola et al., 2015). Floods destroy crops and infrastructure, while droughts reduce yields and water supply, both of which contribute to food shortages (Bello & Bello-Schünemann, 2018).

Floods can quickly devastate crops, infrastructure, and livestock, leading to reduced food production and higher prices (Adekola et al., 2015; Oyekale, 2009). They also trigger disease outbreaks, further complicating food access (Adeloye & Rustum, 2011). Droughts, on the other hand, lead to soil degradation and water scarcity, reducing agricultural productivity, especially in rain-fed systems like those in Nigeria (Ayanlade et al., 2017; Orimoloye et al., 2020). This not only affects food availability but also decreases farmers' income, making food less accessible (Olayide & Tetteh, 2018).

Geographic differences in Nigeria worsen these issues, with the north more prone to droughts and the south to floods (Akinsanola & Ogunjobi, 2014; Adekola et al., 2015). These regional disparities require tailored adaptation strategies (Olaniyi et al., 2013). Additionally, inadequate infrastructure, such as poor storage and road networks, hinders efforts to maintain food security (Adegoke et al., 2014; Adekola et al., 2015).

Social inequality further amplifies the impact of climate change on food security, disproportionately affecting vulnerable groups like women, children, and smallholder farmers (Holmes et al., 2017; Doss et al., 2018). Smallholder farmers, who make up a large part of the agricultural workforce, often lack the resources to adapt to changing climates (Akinbami & Ibikunle, 2019). Women, who are typically responsible for food production, face additional burdens during food shortages (Umoh & Ekanem, 2011), while children suffer from the long-term health impacts of food insecurity (Oyekale, 2009).

As climate change accelerates, the frequency and severity of extreme weather events in Nigeria are expected to increase, posing further threats to food security (Ayanlade et al., 2017). This review examines the complex relationship between food security in Nigeria and floods and droughts occasioned by climate change, highlighting the necessity for all-encompassing and adaptive measures to mitigate the harm they cause and maintain the country's economic resilience.

2. Methodology

The systematic review adhered to PRISMA principles, ensuring a comprehensive and transparent approach to identifying, evaluating, and synthesizing literature on the impact of floods and droughts on food security in Nigeria (Figure 1). The methodology encompassed a rigorous quality assessment, clearly defined inclusion and exclusion criteria, systematic data extraction, and an exhaustive search strategy.

To identify relevant articles published between 2000 and 2024, an extensive search was conducted across academic databases, including Scopus, Web of Science, Google Scholar, and PubMed. Keywords used in the search were "climate change," "droughts," "floods," "food security," "Nigeria," and "adaptation strategies." This initial search yielded 2,500 articles, papers, and documents. To ensure comprehensive coverage, relevant policy documents and reports from governmental and non-governmental organizations were also included in the grey literature.

The selection of papers was guided by predefined criteria. Included studies focused on adaptation strategies to mitigate the impacts of floods and/or droughts on food security in Nigeria, were empirical research, case studies, or reviews published in peer-reviewed journals, and were published within the specified timeframe. Excluded were studies not centered on Nigeria, articles published before 2000 (unless foundational), opinion pieces, editorials, and non-peer-reviewed articles. This filtering process reduced the pool to 450 eligible studies.

Data extraction from these 450 studies involved summarizing key findings, methods, and conclusions. Recorded information included the geographical focus of each study, the specific impacts examined (droughts, floods, or both), adaptation strategies discussed, and relevant statistical data on food prices, agricultural yields, and population impacts.

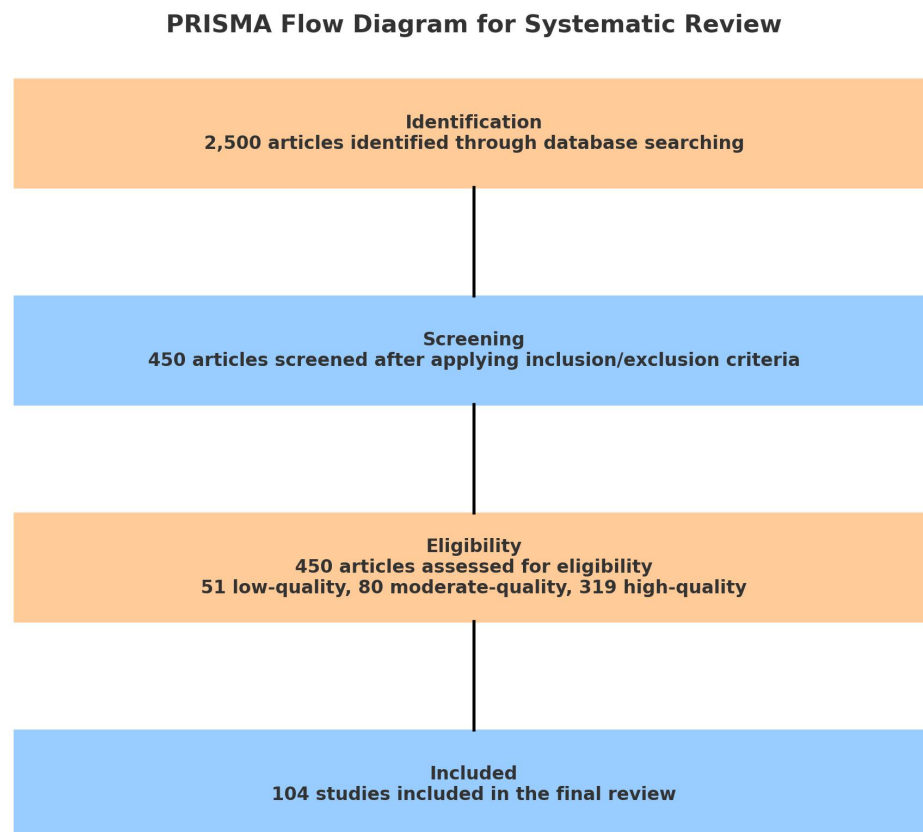


Figure 1: PRISMA flowchart of the research methodology

To ensure the reliability of the review, the Cochrane Risk of Bias tool and the GRADE approach were employed to evaluate the quality of the included studies. The assessment

focused on the quality of the studies' methodologies, their relevance to Nigeria, and the transparency of data reporting. Of the 450 studies reviewed, 51 were rated as low-quality, 80 as moderate-quality, and 319 as high-quality. After further refinement, only 104 studies were ultimately included in the final review. The results were synthesized using qualitative methods, with thematic analysis applied to identify common themes and research gaps

3. Results

3.1 Impacts of Climate-Induced Floods and Droughts on Food Security in Nigeria

3.1.1 Floods and Food Security

Nigeria has experienced increased flooding, especially in coastal areas like the Niger Delta and Lagos. These floods, driven by high rainfall and poor urban planning, severely impact rain-fed agriculture, causing crop destruction and loss of arable land (Abah, 2014; Nkwunonwo et al., 2016). The 2012 floods, among the worst in Nigeria's history, displaced over 2 million people and submerged vast farmlands, leading to sharp declines in staple crop production and exacerbating food insecurity (Oseni et al., 2013; Adegoke et al., 2014). Additionally, disrupted transportation networks hinder market access, leading to post-harvest losses and worsening food insecurity for low-income households (Adeloye & Rustum, 2014; Eze & Ibrahim, 2017).

3.1.2 Droughts and Food Security

Droughts in Nigeria, particularly in the semi-arid north, threaten food security by depleting water resources, reducing soil moisture, and lowering crop yields (Akinsanola & Ogunjobi, 2014). Smallholder farmers, unable to afford alternative water sources, are hardest hit. Recurrent droughts, notably in the 1970s and 1980s, caused significant crop failures, affecting staples like sorghum and millet, essential to the diet of millions of Nigerians (Mortimore, 1989; Olaniyi et al., 2013). Droughts also reduce livestock productivity, further diminishing food availability and household income, especially among pastoral communities in northern Nigeria (Blench, 1999; 2004; Benjaminsen et al., 2012; Bello et al., 2017).

3.1.3 Regional Variations in Climate Impacts on Food Security

Nigeria's diverse climate leads to regional variations in climate impacts. The southern coastal regions suffer from frequent floods that worsen soil salinity and erosion, while the northern Sahelian zones face prolonged droughts, reducing water availability and agricultural output (Adekola et al., 2015; Akinsanola & Ogunjobi, 2014). These regional differences necessitate tailored adaptation strategies, with crops like sorghum and millet in the north, and cassava and yams in the south (Oladipo, 1993; Jalloh et al., 2013).

3.1.4 Socioeconomic Impacts of Climate-Induced Food Insecurity

Climate-induced food insecurity has severe socioeconomic impacts. Rural households, particularly those dependent on agriculture, face reduced income and heightened poverty due to crop and livestock losses (Ogunlela et al., 2011; Bello et al., 2017). Urban areas also suffer as food prices rise, disproportionately affecting the urban poor who rely heavily on markets (Olatunji et al., 2018; Bello & Bello-Schünemann, 2018). Women, critical to food production

and household nutrition, face greater challenges due to limited access to resources, exacerbating gender inequalities (Adamu & Shuaibu, 2017; Duru et al., 2018).

3.2 Adaptation Strategies for Mitigating Climate-Induced Food Insecurity

3.2.1 Technological Innovations

Technological advancements are crucial for enhancing agricultural resilience to climate change. Climate-resilient crop varieties, such as drought-tolerant maize in northern Nigeria, improve food security by maintaining yields under adverse conditions (Oluwatusin, 2014; Oyiga et al., 2016). Improved irrigation methods, like drip irrigation, optimize water use in drought-prone areas but are often inaccessible to smallholder farmers due to high costs (Olayide et al., 2016; Adeola & Adetunbi, 2015).

3.2.2 Policy Interventions

Effective policy measures are essential for building resilience to climate-induced food insecurity. The National Adaptation Strategy and Plan of Action for Climate Change Nigeria (NASPA-CCN) promote sustainable agricultural practices and the integration of climate adaptation into national planning (Federal Ministry of Environment, 2011; Ebele & Emodi, 2016). Regional programs like CAADP also support climate-smart agriculture, though challenges like insufficient funding and weak institutional capacity hinder effectiveness (Ojo & Adebayo, 2012; NEPAD, 2014).

3.2.3 Community-Based Adaptation

Community-based adaptation (CBA) involves local communities in developing and implementing strategies tailored to their specific vulnerabilities. CBA initiatives in Nigeria focus on diversifying livelihoods, promoting climate-resilient agriculture, and managing natural resources sustainably (Ozor et al., 2010; Onyeneke et al., 2018). Community-based early warning systems for droughts and floods empower communities to act quickly, reducing the impact on food security (Nyong et al., 2014; Efe, 2017).

3.2.4 Traditional Knowledge and Indigenous Practices

Traditional knowledge offers valuable insights for climate adaptation. Practices like crop rotation and agroforestry, along with water management techniques such as zai pits and earth bunds, have been used by Nigerian communities to cope with environmental variability (Mertz et al., 2012; Fatunbi et al., 2016). Integrating traditional knowledge with modern strategies can create more effective and culturally relevant adaptation approaches (Reyes-García et al., 2013; Akinkuolie et al., 2024b).

3.2.5 Climate-Smart Agriculture

Climate-smart agriculture (CSA) aims to enhance resilience, reduce emissions, and increase productivity. Practices like conservation agriculture, integrated soil fertility management, and agroforestry are being promoted in Nigeria to improve soil health and water retention, but widespread adoption is limited by farmers' access to resources and knowledge (Pretty et al., 2014; Vanlauwe et al., 2014; Akinkuolie et al., 2024b).

3.2.6 Water Resource Management

Integrated water resource management (IWRM) is key to mitigating the impacts of droughts and floods on food security. Projects like the Water Resources Management and Irrigation Project (WRMIP) aim to improve irrigation efficiency, enhancing agricultural productivity (Giordano & Shah, 2014; Adeoti, 2019). Effective coordination among stakeholders and continuous monitoring are crucial for successful water resource management (Nwafor, 2013).

3.2.7 International and Regional Cooperation

Addressing climate change's impact on food security requires international and regional cooperation. Nigeria participates in initiatives like ECOWAS and UNFCCC, which promote climate adaptation and sustainable agricultural practices (NEPAD, 2014; ECOWAS, 2015). Access to climate finance through mechanisms like the Green Climate Fund is also vital for supporting adaptation efforts (Akinyemi & Kutoma, 2017; Okereke & Coventry, 2016).

4. Discussion

The findings of the review emphasize how intricate and multidimensional Nigeria's food insecurity is as a result of the climate. Numerous factors, such as geographic location, socioeconomic position, and the ability of populations to adapt to changing climatic circumstances, influence how floods and droughts affect food security (Oladipo, 2020). Even while the development of adaptation techniques has advanced significantly, more integrated and comprehensive strategies that address the underlying causes of vulnerability are still required (Oladipo, 2020; Akinbode et al., 2021).

A primary obstacle in mitigating climate-related food insecurity is the need for enhanced collaboration among stakeholders at every tier. Governmental bodies, international organizations, academic and research institutions, along with local communities must work together to adapt effectively (Akinbode et al., 2021). Adewale et al. (2019) suggest that a well-defined policy framework which fosters sustainable farming practices, facilitates the adoption of climate-resilient technology, and guarantees the inclusivity and equity of adaptation measures should serve as the foundation for this collaboration.

Furthermore, more funding is required for climate change adaptation, especially in the fields of infrastructure development, capacity building, and research and development (Fadama III, 2017). To ensure that people have all the resources and knowledge necessary to adapt to the impacts of climate change, this investment should be directed toward the regions and communities who are most at risk (Fadama III, 2017; Adewale et al., 2019).

It is impossible to overestimate the importance of international cooperation and support, especially when it comes to strengthening local communities' ability to adapt to climate change. This support can come in the form of funds, technical expertise, and the exchange of best practices from other countries dealing with similar challenges (IITA, 2018).

4.1 Challenges in Implementing Adaptation Strategies

Although many adaptation options have been identified and put into practice, their efficacy is hampered by a number of issues. These difficulties include weak institutional capability, insufficient funding, and inadequate infrastructure (Amusan & Olutola, 2017; Akintoye & Akinola, 2020). Furthermore, overlaps and inconsistencies caused by Nigeria's fragmented policy implementation process usually compromise the effectiveness and coherence of adaptation efforts (Amusan & Olutola, 2017; Okunade et al., 2019).

The mismatch between national policies and regional realities must also be addressed. There is a disconnect between policy objectives and local needs as a result of the national design of many adaptation programs with very little input from local communities (Intergovernmental Panel on Climate Change (IPCC), 2014; Oladipo, 2020). In order to make adaptation measures more relevant and effective, it can be helpful to increase the involvement of communities in their design and implementation (Akintoye & Akinola, 2020; Oladipo, 2020).

4.2 Opportunities for Scaling Up Adaptation Initiatives

Notwithstanding challenges, there are numerous opportunities to expand effective adaptation initiatives. Adoption of stronger and more long-lasting adaptation strategies is made possible by the increased public understanding of climate change and its effects on food security (IITA, 2018). This can be accomplished by promoting public-private partnerships, boosting investment in climate-resilient infrastructure, and mainstreaming climate adaptation into national development planning (IITA, 2018; United Nations Development Programme (UNDP), 2019).

Using digital technologies to improve climate adaptation is another possibility. For example, farmers can make informed choices and apply best practices through the utilization of mobile apps and internet platforms for exchanging agricultural advice and climatic information (World Bank, 2020). Likewise, monitoring and management of climate risks can be strengthened by the use of remote sensing and geographic information systems (GIS), enabling more focused and timely actions (World Bank, 2020).

4.3 Future Research Directions

The knowledge gaps in our understanding of the intricate relationships between food security, adaptation strategies, and climate change should be the primary goal of future study. This entails looking into how diverse agricultural systems may be affected by climate change in the long run, evaluating the efficacy of different adaptation strategies, and researching how novel technologies might improve resilience (Fadama III, 2017; Akinbode et al., 2021).

In addition, more regional research is required, with an emphasis on the unique socioeconomic, cultural, and climatic conditions of Nigeria's various regions (Oladipo, 2020). These kinds of studies can provide helpful details about specific challenges and opportunities associated with local climate adaptation. Furthermore, the development of more robust and integrated adaptation strategies can be aided by multidisciplinary research that brings together ideas from the social sciences, economics, agriculture, and climate science (Adewale et al., 2019; Akintoye & Akinola, 2020).

5. Conclusion

Climate change makes floods and droughts more frequent and dangerous for Nigeria's food security. While many different adaptation strategies have been put into practice, continuous innovation is important for scaling up successful programs and guaranteeing their long-term efficacy. Building resilience requires promoting methods of sustainable agriculture and including climate change adaptation into national development planning.

The necessity of improved collaboration between government agencies, development partners, and local communities is emphasized by this review. To mitigate the impacts of climate change on Nigeria's food systems, increased funds must be committed to climate-smart agriculture, water resource management, and other adaptation measures.

In a nutshell, Nigeria has a lot of opportunities to build a more resilient and sustainable food system, even if it also faces a lot of challenges in adapting to climate-induced food insecurity. The country can more effectively ensure food security and improve the standard of living for millions of its people by utilizing the synergies between traditional and modern adaptation strategies, fostering regional and international cooperation, and focusing on these areas in future research and policy initiatives.

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