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Climate Change and Human Security: Implications for Sustainable Development

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ABSTRACT

Climate change poses significant threats to human security and sustainable development in semi-arid regions of Nigeria. This study examines the effects of climate change on human security and sustainable development in Biu Local Government Area (LGA), Borno State. Drawing on secondary climatic data, empirical studies, and policy documents, the paper analyses temperature trends, rainfall variability, and drought frequency, and assesses their impacts on food, water, health, economic, environmental, and community security. Findings from Biu and wider Borno indicate approximately 1.5°C temperature rise and 15% rainfall decline over recent decades, contributing to reduced crop yields, water stress, health risks, and livelihood erosion. These changes constrain progress toward Sustainable Development Goals (SDGs) 1, 2, 3, 6, and 13. Local coping strategies exist but remain limited by structural barriers. The study concludes with recommendations for climate-resilient agriculture, water management, and integrated policy responses tailored to Biu LGA.

Keywords: Climate change, human security, sustainable development, Biu LGA, Borno State, Nigeria

1. Introduction

Climate change has emerged as one of the most significant global challenges of the twenty-first century, with profound consequences for environmental sustainability, socio-economic development, and human well-being. Driven primarily by anthropogenic greenhouse gas emissions, climate change is manifested through rising global temperatures, changing precipitation patterns, prolonged droughts, floods, heatwaves, sea-level rise, and increasing frequency of extreme weather events. These climatic changes have disrupted natural ecosystems and intensified existing vulnerabilities, particularly in developing countries where livelihoods are highly dependent on climate-sensitive sectors such as agriculture, forestry, and water resources. According to the Intergovernmental Panel on Climate Change (IPCC, 2023), climate change has already caused widespread adverse impacts on ecosystems and human systems, with

future risks expected to increase unless significant mitigation and adaptation measures are implemented. Consequently, climate change has evolved beyond an environmental issue to become a major obstacle to economic growth, poverty reduction, and sustainable development worldwide (IPCC, 2023; United Nations, 2023).

The growing recognition of climate change as a threat to human security has shifted global discourse from traditional state-centred security to a people-centred approach that emphasizes the protection of individuals and communities from threats that undermine their survival, livelihoods, and dignity. Human security encompasses multiple dimensions, including food security, water security, health security, economic security, environmental security, personal security, community security, and political security (United Nations Development Programme [UNDP], 1994). Climate change exacerbates these dimensions by reducing agricultural productivity, increasing water scarcity, spreading climate-sensitive diseases, damaging infrastructure, displacing populations, and intensifying competition over diminishing natural resources. These impacts are particularly severe in Sub-Saharan Africa, where widespread poverty, weak institutions, rapid population growth, and limited adaptive capacity increase vulnerability to climate-related shocks (IPCC, 2022). As a result, climate change has become a critical development challenge that threatens both human security and socio-economic stability.

Nigeria is among the African countries most vulnerable to the adverse effects of climate change due to its diverse ecological zones, high dependence on rain-fed agriculture, rapid urbanization, and widespread poverty. In northern Nigeria, increasing temperatures, erratic rainfall, desertification, land degradation, and recurrent droughts have significantly affected agricultural production, food availability, water resources, and rural livelihoods. These environmental changes have heightened household vulnerability, increased rural–urban migration, and intensified conflicts over land and water resources, particularly in the Sudano-Sahelian region. Furthermore, climate-induced livelihood losses interact with existing socio-economic challenges, including unemployment, insecurity, and inadequate infrastructure, thereby undermining efforts to achieve inclusive development and improve living standards (Federal Ministry of Environment, 2021; IPCC, 2022). The interconnected nature of these challenges demonstrates that climate change is not merely an environmental concern but a multidimensional threat to human security and national development.

The concept of sustainable development provides a comprehensive framework for addressing the interconnected challenges posed by climate change and human insecurity by promoting a balance between environmental protection, economic growth, and social well-being. The adoption of the Sustainable Development Goals (SDGs) by the United Nations underscores the importance of climate action (SDG 13) as a prerequisite for achieving other development goals, including poverty eradication, food security, good health, clean water, and resilient communities (United Nations, 2015). Despite increasing research on climate change, many studies have focused primarily on environmental or agricultural impacts, with relatively limited attention given to its broader implications for human security and sustainable development, particularly in developing countries. Therefore, examining the complex relationship between climate change, human security, and sustainable development is essential for generating evidence-based policies

and adaptation strategies that enhance resilience, reduce vulnerability, and support the achievement of sustainable development objectives in climate-sensitive regions.

2. Conceptual and Theoretical Framework

2.1 Concept of Climate Change

Climate change refers to long-term alterations in the Earth's climate system, characterized by persistent changes in temperature, precipitation patterns, wind regimes, and the frequency and intensity of extreme weather events over several decades or longer. While natural processes such as volcanic eruptions and variations in solar radiation have historically influenced the climate, overwhelming scientific evidence demonstrates that contemporary climate change is predominantly driven by anthropogenic activities, particularly the combustion of fossil fuels, deforestation, industrialization, and unsustainable land-use practices, which have substantially increased atmospheric concentrations of greenhouse gases such as carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O) (IPCC, 2023). These changes have accelerated global warming, resulting in rising sea levels, glacier retreat, biodiversity loss, ocean acidification, and increasing occurrences of droughts, floods, heatwaves, and other climate-related hazards that threaten ecosystems and human livelihoods (IPCC, 2022).

2.2 Concept of Human Security

Human security is a people-centred concept that focuses on protecting individuals from threats to their survival, well-being, and dignity rather than emphasizing state security alone. Introduced by the United Nations Development Programme (UNDP**)**, it encompasses dimensions such as food, health, economic, environmental, and personal security (UNDP, 1994). Climate change has increasingly been recognized as a major threat to human security because it undermines livelihoods, food production, water availability, and public health, particularly in vulnerable developing regions (Commission on Human Security, 2003; IPCC, 2022). Thus, the human security framework provides a holistic perspective for understanding the link between climate change and sustainable development.

2.3 Concept of Sustainable Development

Sustainable development refers to a development approach that meets present societal needs without compromising the ability of future generations to meet their own needs. It integrates three interdependent dimensions economic growth, social equity, and environmental protection—to promote long-term human well-being while ensuring the sustainable use of natural resources. In the context of climate change, sustainable development emphasizes building resilient communities through climate adaptation, efficient resource management, poverty reduction, and environmental conservation. This concept gained global prominence through the World Commission on Environment and Development report, Our Common Future, and was further reinforced by the adoption of the United Nations Sustainable Development Goals (SDGs), which recognize climate action as fundamental to achieving inclusive and sustainable development (WCED, 1987; United Nations, 2015; Sachs, 2015).

2.4 Theoretical Framework

i. **Human Security Approach**, popularised by the United Nations Development Programme (UNDP) in its 1994 Human Development Report, shifts the focus of security from the state to the individual and community. It identifies multiple interconnected dimensions of security food, health, economic, environmental, personal, community, and political—that can be threatened by non-military sources such as climate change. In the context of Biu Local Government Area, this framework is particularly useful because rising temperatures, erratic rainfall, and recurrent droughts directly undermine food production, water availability, health outcomes, and livelihoods, thereby eroding the freedom from want and freedom from fear of local populations.

ii. **Sustainable Livelihoods Framework** (developed by the UK Department for International Development and others) analyses how households combine different assets—natural, physical, human, financial, and social capital—within a vulnerability context shaped by trends, shocks, and seasonality. Climate change acts as a major external shock and long-term trend that depletes natural capital (soil, water, vegetation) and reduces the productivity of other assets in Biu LGA. The framework helps explain how farmers' coping and adaptation strategies (early planting, crop diversification, livelihood diversification) attempt to maintain or rebuild livelihood security under increasing climatic stress, while also highlighting the institutional and policy structures that enable or constrain these responses.

iii. **Climate-Security Nexus** (or climate-conflict/security nexus) examines the pathways through which climate change interacts with existing social, economic, and political vulnerabilities to generate insecurity. It emphasises that climate impacts rarely cause conflict or insecurity in isolation; rather, they act as threat multipliers by intensifying resource competition, migration pressures, and livelihood collapse. In Borno State and the wider Lake Chad Basin, this perspective is relevant because climate-induced scarcity of water, pasture, and fertile land can heighten tensions and mobility, even in relatively more stable areas such as Biu LGA, thereby linking environmental change to broader human security outcomes.

Although all three frameworks offer valuable insights, this study adopts the **Human Security Approach** as its primary theoretical lens. The Human Security Approach is preferred because it comprehensively captures the multi-dimensional impacts of climate change on the people of Biu LGA covering food, water, health, economic, environmental, and community security while remaining people-centred rather than state-centred. Unlike the Sustainable Livelihoods Framework, which focuses mainly on household asset strategies, or the Climate-Security Nexus, which tends to emphasise conflict and political pathways, the Human Security Approach provides a broader and more balanced analytical umbrella that directly connects climate stressors to both immediate human well-being and longer-term sustainable development goals. This makes it the most suitable foundation for examining the interconnected challenges of climate change, human security, and sustainable development in the study area

2.5 Empirical Review of Climate Change, Human Security and Sustainable Development

Global Evidence on Climate Change and Human Security

Empirical evidence from global climate assessments demonstrates that climate change has evolved beyond an environmental challenge to become a major threat to human security and sustainable development. Increasing global temperatures, changing precipitation patterns, droughts, floods, heatwaves, and ecosystem degradation have created complex risks for human well-being, particularly in vulnerable communities. The Intergovernmental Panel on Climate Change (IPCC, 2022) reported that climate change is already affecting natural and human systems through reduced agricultural productivity, increasing water stress, health risks, livelihood disruption, and damage to infrastructure. These impacts are unevenly distributed, with developing regions experiencing greater vulnerability due to poverty, limited adaptive capacity, dependence on natural resources, and weak institutional resilience.

The human security perspective provides a broader understanding of these impacts by examining how climate change affects food security, water security, health security, economic security, environmental security, and community security. The United Nations Development Programme (UNDP, 1994) conceptualised human security as protection from threats that undermine survival, livelihoods, and dignity. From this perspective, climate change represents a multiplier of existing vulnerabilities because it intensifies resource scarcity, economic instability, and social inequalities. Global evidence therefore indicates that achieving sustainable development requires integrated approaches that address climate risks alongside poverty reduction, food systems, health protection, and environmental management.

African Evidence

Across Africa, empirical studies show that climate change has intensified existing development challenges because many communities depend directly on climate-sensitive sectors such as agriculture, livestock production, and natural resources. The IPCC (2022) identified Africa as one of the regions most vulnerable to climate change due to increasing temperatures, rainfall variability, drought frequency, land degradation, and limited adaptive capacity. These climatic pressures have contributed to declining agricultural productivity, reduced water availability, food insecurity, and increased livelihood vulnerability.

Studies across sub-Saharan Africa indicate that climate variability affects rural households through multiple pathways. Changes in rainfall timing and intensity influence agricultural production, while prolonged dry periods reduce water availability for domestic and productive activities. Climate-related health risks have also increased through greater exposure to heat stress, water-borne diseases, and malnutrition associated with food insecurity. These impacts demonstrate that climate change affects several dimensions of human security simultaneously rather than producing isolated environmental consequences.

Furthermore, African studies emphasise that climate impacts interact with existing socio-economic conditions, including poverty, population growth, weak infrastructure, and governance challenges. Consequently, climate change has become an important barrier to sustainable development by limiting progress in poverty reduction, food security, health improvement, and environmental sustainability.

Evidence from Nigeria

Within Nigeria, empirical studies have demonstrated that climate change is increasingly affecting agricultural production, livelihoods, food availability, and environmental sustainability. Nigeria's vulnerability is associated with its large dependence on rain-fed agriculture, rapid population growth, environmental degradation, and regional differences in climatic conditions. Studies have reported increasing temperatures, changing rainfall patterns, drought occurrences, and extreme weather events across different ecological zones of the country.

Olanrewaju and Joshua (2022) found that climate variability has contributed to declining agricultural productivity and food insecurity in Nigeria, with consequences for rural livelihoods and household vulnerability. Their findings indicate that climate change should be considered a human security issue because its effects extend beyond agricultural losses to influence poverty, economic stability, and social well-being.

Similarly, Atedhor et al. (2021), through a review of climate change studies in Nigeria, observed that although substantial research has examined climate impacts on agriculture and the environment, fewer studies have integrated these impacts within a broader human security and sustainable development framework. This indicates a need for research that examines how climate change simultaneously affects multiple dimensions of human security, particularly in vulnerable rural communities.

Evidence from Northern Nigeria and Lake Chad Basin

Northern Nigeria and the wider Lake Chad Basin represent some of the most climate-sensitive regions in West Africa. Empirical studies from this region indicate that increasing temperatures, declining rainfall reliability, drought, and environmental degradation have affected agricultural productivity, pastoral livelihoods, water resources, and community resilience.

Wakdok and Bleischwitz (2021) examined the relationship between climate change, resource availability, and security challenges in northern Nigeria and the Lake Chad Basin. Their findings showed that declining water resources, land degradation, and livelihood pressures have intensified competition over natural resources. However, the study emphasised that climate change does not independently cause insecurity; rather, it interacts with existing social, economic, and institutional vulnerabilities to increase risks.

The Lake Chad Basin provides an important example of the climate-security relationship because environmental changes have contributed to livelihood disruption, migration pressures, and increased competition over limited resources. These conditions demonstrate the importance of analysing climate change through a human security perspective, particularly in semi-arid regions where communities depend heavily on natural resources.

Evidence Specifically Related to Biu/Borno

Evidence from Borno State and Biu Local Government Area indicates that climate change has affected agricultural activities, livelihood systems, and environmental conditions. Studies within Biu and surrounding areas have reported changes in rainfall patterns, increasing temperatures, shortened growing seasons, and increasing challenges associated with drought and agricultural productivity.

Available studies focusing on Biu indicate that farmers have observed climatic changes including delayed rainfall onset, early cessation of rainfall, increasing temperatures, and declining rainfall reliability. These climatic changes have influenced crop production, particularly for crops such as maize, millet, sorghum, and groundnut. Previous findings reported reductions in agricultural output associated with rainfall variability and drought conditions, increasing household vulnerability and dependence on adaptation strategies.

At the broader Borno State level, studies have similarly identified climate variability as a major factor affecting agricultural livelihoods, water availability, and environmental sustainability. The Climate-Smart Agriculture Investment Plan for Borno State highlights the need for improved climate adaptation through sustainable agricultural practices, improved extension services, water management, and climate information systems (Bougouma et al., 2023).

Despite these contributions, most available studies in Borno and Biu have focused mainly on agricultural impacts, farmer perceptions, and adaptation practices. Less attention has been given to examining climate change as a multidimensional human security challenge involving interconnected effects on food, water, health, economic, environmental, and community security.

Summary of Empirical Limitations and Need for This Chapter

The reviewed literature demonstrates that climate change has significant implications for human security and sustainable development at global, African, Nigerian, and regional levels. However, important limitations remain. First, many existing studies examine climate impacts from a single perspective, particularly agriculture, rainfall variability, or environmental degradation, without integrating multiple dimensions of human security. Second, evidence from Nigeria has largely focused on national or regional patterns, with limited attention to local government-level vulnerabilities.

Within Borno State, existing research has improved understanding of climate variability, agricultural challenges, and adaptation responses, but evidence specifically examining Biu LGA remains limited. Furthermore, few studies have applied the Human Security Approach to explain

how climate change simultaneously influences food security, water security, health security, economic security, environmental security, and community security.

This chapter addresses these limitations by synthesising available evidence from Biu LGA, Borno State, northern Nigeria, and the Lake Chad Basin within a human security and sustainable development framework. The approach provides a broader understanding of climate-related vulnerabilities and identifies policy directions for strengthening resilience in climate-sensitive communities.

2.6 Research Gap

Despite increasing research on climate change impacts in Nigeria, significant gaps remain in understanding the relationship between climate change, human security, and sustainable development at the local level. Previous studies have mainly focused on agricultural productivity, climate variability, drought, desertification, and farmers' adaptation strategies. While these studies provide valuable information, they often examine climate impacts separately rather than considering the interconnected effects on multiple dimensions of human security.

Furthermore, most existing research has been conducted at national or regional scales, with limited empirical attention given to Biu Local Government Area despite its vulnerability to climatic variability and dependence on climate-sensitive livelihoods. Studies within Borno State have documented rising temperatures, changing rainfall patterns, and declining agricultural productivity; however, the broader consequences for food security, water security, health outcomes, livelihoods, environmental sustainability, and community resilience remain insufficiently explored.

Therefore, this chapter addresses the existing knowledge gap by integrating climate change, human security, and sustainable development into a unified analytical framework. By synthesising evidence from Biu LGA and wider Borno State, the chapter provides a more comprehensive understanding of how climate change influences human well-being and sustainable development outcomes in vulnerable semi-arid communities.

3. Methodology

3.1 Study Area

Biu L.G..A is situated roughly 210 kilometers from Biu, LGA in the southern region of Borno State (Nigeria Mapping Company, 1999). It is situated between latitudes10.250N and 11.000N and longitudes 11.420E and 12.300E (fig. 1). According to the National Population Commission (2006), it had a population of roughly 175,760 in 2006 and was expected to reach 257,500 by 2025 at a 3.4% growth rate. It is situated in the Northern Guinea savanna (NGS) agro-ecological zone, with a small fraction in the northeast, the Kimber area, falling in the drier Sudan savanna zone. It is situated on the Biu plateau, with an average elevation of 626 meters above sea level (Amaza et al., 2007). The research area isbounded to the north by the LGAs of Damboa, Chibok, and Askira UBA; to the south, it issurrounded by the LGAs of Bayo, Kwaya Kusar, and Shani (Britannica, 2009).

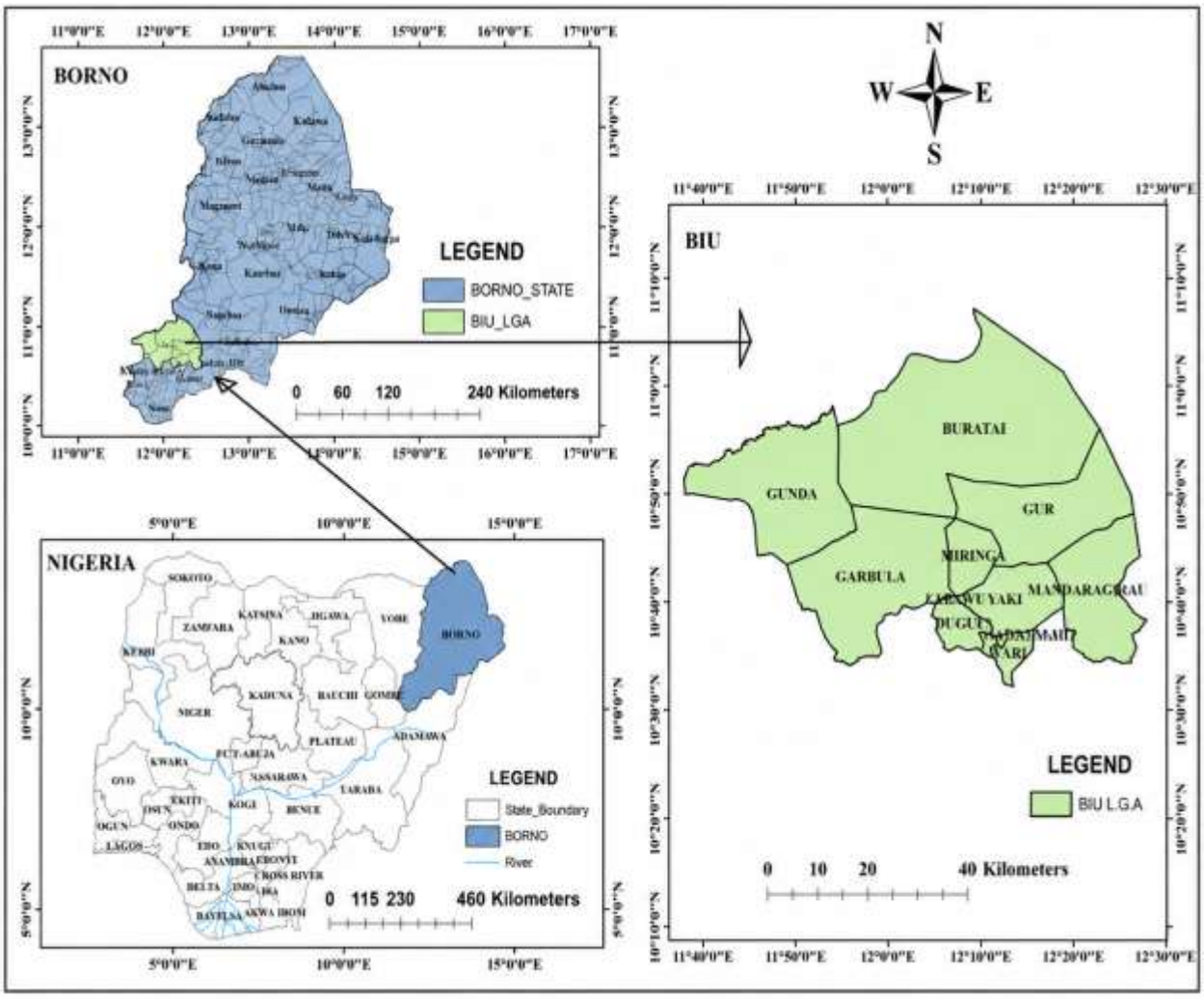


Figure 1: Map of Study Area
Source: GOGIS, 2026

3.2 Materials and Methods

3.2.1 Research Design

This chapter adopts a qualitative desk-based narrative literature review approach to examine the relationship between climate change, human security, and sustainable development in Biu Local Government Area (LGA), Borno State, Nigeria. The review does not involve primary climatic measurements, household surveys, or field-based data collection. Instead, it synthesises existing scientific literature, institutional reports, policy documents, and previous empirical studies to develop an integrated understanding of how climate change influences different dimensions of human security and sustainable development. The narrative review approach was adopted because available evidence on climate change impacts in Biu LGA is distributed across different forms of literature, including climate studies, agricultural research, livelihood assessments,

government reports, and regional climate assessments. This approach allows evidence from diverse sources to be analysed collectively while identifying knowledge gaps and policy implications relevant to the study area.

3.2.2 Literature Search Strategy

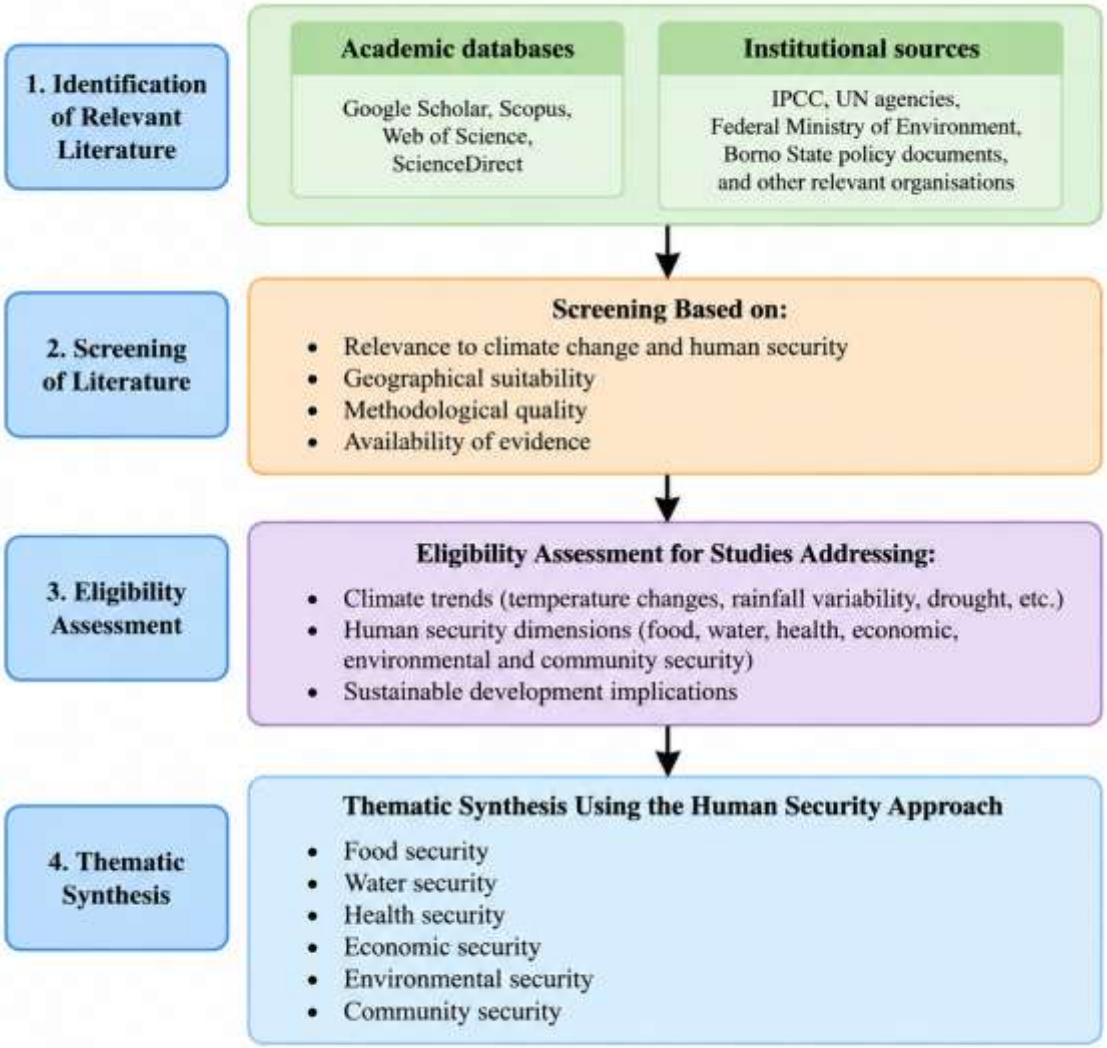
Relevant literature was identified through searches of academic databases and institutional repositories. The databases consulted included Google Scholar, Scopus, Web of Science, and ScienceDirect. Additional evidence was obtained from official publications of recognised institutions, including the Intergovernmental Panel on Climate Change (IPCC), United Nations agencies, Federal Ministry of Environment Nigeria, Borno State climate-related policy documents, and relevant development organisations.

The literature search focused on studies addressing climate change trends, climate variability, drought, rainfall changes, temperature increase, adaptation strategies, livelihood vulnerability, human security, and sustainable development. Search terms included combinations of:

i. “climate change” AND “human security”;
ii. “climate variability” AND “Borno State”;
iii. “Biu LGA” AND “climate adaptation”;
iv. “temperature trends” AND “Northern Nigeria”;
v. “rainfall variability” AND “food security”;
vi. “climate change” AND “sustainable development”;
vii. “Lake Chad Basin” AND “climate security”.

Boolean operators such as AND & OR were used where necessary to combine related concepts and improve identification of relevant sources.

Figure 1: Framework for Literature Identification and Selection in the Narrative Review



Source: Author's construction based on the narrative literature review methodology adopted in this chapter.

3.2.3 Selection Criteria for Reviewed Literature

The selection of literature was guided by relevance, credibility, geographical applicability, and contribution to the objectives of the chapter.

Studies were included where they:

1. examined climate-related changes, including temperature trends, rainfall variability, drought, flooding, or environmental degradation;
2. discussed implications for human security dimensions such as food, water, health, economic, environmental, or community security;

3. focused on Biu LGA, Borno State, northern Nigeria, the Lake Chad Basin, or comparable semi-arid environments;
4. presented evidence-based findings from clearly described research methods;
5. contributed to understanding climate change adaptation and sustainable development challenges.

Sources were excluded where they:

1. lacked sufficient methodological explanation;
2. were unrelated to climate change, human security, or sustainable development;
3. contained unsupported opinions without evidence;
4. had limited relevance to the geographical and conceptual focus of the chapter.

3.2.4 Assessment of Source Quality

The quality and relevance of reviewed materials were assessed based on the credibility of the source, methodological transparency, geographical relevance, and reliability of reported findings.

Greater emphasis was placed on peer-reviewed journal articles, IPCC assessment reports, United Nations publications, and government policy documents because these sources undergo established review processes and provide recognised evidence for climate change assessment and policy development.

Where findings differed between studies, evidence was compared based on study location, period of analysis, research methods, and type of data used. Differences were interpreted within their specific contexts rather than treated as contradictions. This approach allowed consideration of variations between local, regional, and broader climate assessments.

3.2.5 Classification of Evidence Sources

To ensure appropriate interpretation of evidence, reviewed materials were classified into three geographical categories: Biu-specific evidence: Studies directly examining climate conditions, agricultural impacts, farmer perceptions, or adaptation practices within Biu Local Government Area. Borno State evidence: Studies covering multiple locations within Borno State that provide wider understanding of climate trends, livelihood vulnerability, and adaptation challenges. Northern Nigeria and Lake Chad Basin evidence: Studies providing broader regional context on climate change, resource pressure, human security, and sustainable development challenges in semi-arid environments.

This distinction is important because evidence directly available for Biu LGA remains limited compared with broader studies conducted across Borno State and northern Nigeria. The chapter therefore uses Biu-specific evidence where available and incorporates regional evidence to provide contextual interpretation.

Table 1: Categories of Evidence Reviewed in the Narrative Literature Synthesis

Evidence category	Main contribution
Peer-reviewed journal articles	Empirical evidence on climate trends, livelihoods, agriculture, and human security
International reports (IPCC and United Nations agencies)	Global and regional climate assessments and sustainable development perspectives
Government and policy documents	National and state climate policies, adaptation strategies, and institutional responses
Biu and Borno-specific studies	Local evidence on climate impacts, perceptions, and adaptation practices

Source: Author's compilation from reviewed literature and documentary sources.

3.2.6 Interpretation of Quantitative Findings

The numerical information presented in this chapter, including reported temperature changes, rainfall decline, agricultural losses, and farmer perception statistics, was obtained from previously published studies and institutional reports. These values were not generated from new statistical analysis or primary climate observations. Each reported figure was interpreted according to the geographical area, period, and methodology of the original source. For example, reported changes in temperature, rainfall patterns, and agricultural productivity were synthesised from available studies examining Biu LGA and wider Borno State rather than from newly collected field data.

3.6 Data Synthesis Approach

The extracted information was analysed using thematic synthesis guided by the Human Security Approach. Evidence was organised according to the major dimensions of human security:

i. food security;
ii. water security;
iii. health security;
iv. economic and livelihood security;
v. environmental security;
vi. community security.

This thematic organisation enabled the chapter to integrate findings from different sources and explain the interconnected effects of climate change on human well-being and sustainable development in Biu LGA.

RESULTS AND DISCUSSION

4. Climate Change Trends and Manifestations in Biu LGA

The empirical evidence from Biu Local Government Area and the greater Borno State demonstrates a significant and progressive climatic change over the last decades. Multi-decadal climatic record analyses and farmer perception studies have repeatedly shown increasing temperatures, decreasing and more unpredictable rainfall, shorter growing seasons and more frequent droughts. These patterns are generally comparable with data in the Lake Chad Basin and northern Nigeria, giving them dependability while highlighting the need for further high-resolution local monitoring on the Biu Plateau.

4.1 Temperature Changes

Studies conducted in Biu LGA have shown an increase in the average temperature by about 1.5oC in the past decades. This warming is also supported by polls of farmers, with the majority of respondents citing rising temperatures as one of the most obvious effects of climate change. Larger studies that included Biu and other Borno LGAs indicated that over 80% of farmers saw increased temperatures (Zanna, 2026). The observed warming has various direct consequences. Higher temperatures increase evaporative demand, hasten soil moisture loss and worsen heat stress on crops and cattle. They also limit the effective growing season and increase the danger of heat-related health concerns for rural people. These impacts together undermine the durability of rain-fed agriculture which is the dominant economic base of Biu LGA.

4.2 Rainfall Variability

In Biu, the rainfall patterns have become decidedly less predictable. Studies show an average reduction of the yearly rainfall of 15% with a greater inter-annual variability. Farmers routinely report the delayed (or deceptive) commencement of showers, early conclusion of the rainy season and declines in rainfall quantity and reliability. Such changes have reduced the growing season and disturbed customary planting dates. Crops particularly susceptible to the timing and distribution of rainfall, including maize, millet, sorghum, and peanuts, are important in local food systems. A late start combined with an early end shortens the window during which farmers can successfully grow crops, increasing the chance of crop failure even if total rainfall is close to normal.

4.3 Drought and Environmental Degradation

Droughts have become more frequent with a number of severe events documented between 2010 and 2020. The droughts interact with and exacerbate the long-term environmental degradation processes already in progress on the Biu Plateau, which include soil erosion, loss of vegetation and reduced soil fertility. The cover of vegetation has been diminished and soils exposed to erosion, especially on the high topography of the plateau, as a consequence of continuous farming and overgrazing. This leads to a reduction in soil organic matter and water holding capacity, which further restricts the ability of the landscape to buffer rainfall unpredictability. Consequently, even moderate dry spells today have more serious implications on crop production and water supplies than they did many decades ago.

Implications for Human Security

The reported rise in temperature, the loss and variability in rainfall, the increased incidence of drought, and ongoing environmental degradation all combine to produce cascading threats across many dimensions of human security. Lower and less dependable yields of crops jeopardise food security; higher evaporative demand and seasonal water scarcity threaten water security; heat stress, risks of malnutrition and exposure to waterborne diseases threaten health security; losses of livelihood from agriculture threaten economic security; and degradation of the natural resource base threatens environmental and community security. These interlinked pressures impede development on multiple Sustainable Development Goals and increase the overall vulnerability of households and communities in Biu LGA.

5. **Effects of Climate Change on Human Security in Biu LGA**

Climate change is a critical threat multiplier in Biu Local Government Area, threatening several interconnected dimensions of human security. Based on evidence from Biu, wider studies from Borno State and regional assessments from the Lake Chad Basin, this section examines how rising temperatures, changing rainfall patterns and more frequent droughts lead to actual risks to food, water, health, economic, environmental and community security.



Figure 2: Word cloud of major climate change impacts on human security in Biu LGA

5.1 Food Security

Empirical data from Biu LGA demonstrate that climate change has a devastating effect on agricultural productivity. Research estimates a 15 percent reduction in yearly rainfall and a 1.5 degree Celsius increase in temperatures, resulting in reduced growing seasons and increasing droughts. These changes have resulted in serious losses in crop production, notably for staple crops such as maize, millet, sorghum and peanuts. One study found that rice output declined by 27% under erratic rainfall and extended dry spells, while more general surveys covering Biu and surrounding LGAs found that 72% of farmers experienced yield decreases (Zanna, 2026). Farming has become more difficult. Farmers are often challenged by late or false commencement of rainfall, early end of the wet season and increased temperatures which raise crop water stress and impair soil moisture retention. Such climatic stressors might upset customary planting schedules and increase the likelihood of crop loss. Therefore, the supply of local foods has diminished, thereby raising the household reliance on market purchases and subjecting the communities to price fluctuations. Reduced on-farm output thus undermines both access to and adequacy of food, placing food security under ongoing pressure.

5.2 **Water Security**

“Rainfall variability is a major cause of water insecurity in Biu LGA. The decrease in annual rainfall and the increase in inter-annual variability have undermined the trustworthiness of surface and groundwater sources. Higher temperatures also increase evaporative demand, exacerbating the drying out of seasonal streams and lowering of water tables in the lengthy dry season (November–March). Water use for home and agricultural purposes has grown increasingly limited. Households have to travel longer and spend more time to get household water . Small-scale irrigation and livestock watering are disturbed from time to time . Previous assessments of domestic water supply in Biu had previously revealed pressures associated with population increase. Climate factors have aggravated these challenges by lowering recharge rates and increasing the acuity of seasonal scarcity. The cumulative result is increased competition for scarce water resources and lower resilience of water-based livelihoods.

5.3 Health Security

Climate change increases several health concerns in Biu LGA. Higher temperatures exacerbate heat stress, especially for outside agricultural labourers and vulnerable populations such as the elderly and children. However, irregular rainfall and water scarcity create conducive conditions for water-borne infections as people resort to dangerous sources during dry periods. Another important avenue is malnutrition. Decreased yields and household food availability directly impact dietary diversification and calorie intake. Southern Borno has long suffered from high levels of malnutrition which are being exacerbated by losses in crop output and revenue due to climate, with women and children being the most affected. The net effect of these changes is an increase in climate-sensitive disease loads and a decline in overall health security.

5.4 Economic and Livelihood Security

Agriculture is still the mainstay of the livelihood foundation in Biu LGA. The documented losses in yields from crops and increasing hazards of production have resulted in decreases in farm earnings. Households reliant on rain-fed agriculture face diminishing profits, limited capacity to invest in productive assets and growing challenges in satisfying basic necessities. Losing your livelihood is more than losing your crops. Lack of pasture and water stress restrict livestock output and non-farm income alternatives are limited. Adaptation itself has costs: acquisition of improved seeds, temporary irrigation or diversification of livelihoods typically demands funds that many households do not have. Climate change thereby erodes economic security, heightens the probability of distress coping methods and diminishes long-term resilience of livelihoods.

5.5 Environmental Security

Climate change is interacting with and accelerating environmental degradation in Biu LGA. Higher temperatures and lower rainfall lead to loss of vegetation, reduced soil moisture and greater susceptibility to erosion . Continuous farming under these conditions further reduces the fertility of the soil, while overgrazing and collection of fuelwood further aggravate land degradation. These processes degrade the natural resource basis that local livelihoods depend on. Feedback loops between soil deterioration and vegetation loss undermine future agricultural potential and landscape's ability to buffer climatic shocks, decreasing environmental security.

5.6 Community Security

Although Biu LGA has been more stable than northern Borno State, climate-induced resource constraint creates additional challenges for community security. The decreasing amount of rich land, pasture, and water raises rivalry among farming and herding households. Such competitiveness can exacerbate local tensions and lead to social unrest. Migration pressure is another path. Seasonal or permanent outmigration in search of more stable employment can upset family structures, lower local labour supply, and put additional demand on recipient communities. Households without diverse economic sources or strong social networks are more vulnerable. Climate change works as a threat multiplier, combining with existing socioeconomic conditions to degrade community cohesion and collective resilience. These six characteristics, when taken together, show that climate change has far-reaching consequences in Biu LGA. Rather, it creates a cascade of mutually reinforcing dangers that jeopardise human security and impede progress toward sustainable development.

6. **Climate Change, Human Security and Sustainable Development**

Climate change consequences in the Biu Local Government Area directly hamper progress toward multiple Sustainable Development Goals (SDGs), highlighting the complex relationship between environmental change, human security, and long-term development results. According to **SDG 1 (No Poverty),** climate-induced declines in agriculture production and household income diminish most citizens' principal livelihoods. Declining crop yields, animal losses, and rising production costs drive vulnerable agricultural households deeper into poverty, limiting their ability to amass assets or invest in alternative income sources.

SDG 2 (Zero Hunger) has similar constraints. Rainfall variability, short growing seasons, and recurring droughts all affect the output of staple crops including maize, millet, sorghum, and groundnuts. These shortages reduce local food supply, increase market dependence, and raise the risk of food insecurity, particularly among poorer households.

SDG 3 (Good Health and Well-Being) is touched by a number of paths. Heat stress, the growth of water-borne infections connected to poor water quality, and malnutrition caused by diminished food output and income all raise health concerns. Children and women, who often shoulder greater dietary and care obligations, are particularly vulnerable.

SDG 6 (Clean Water and Sanitation) is jeopardised by decreased rainfall consistency, increased evaporative demand, and seasonal water scarcity. These conditions restrict the amount and quality of water available for home and agricultural use, increasing competition for scarce water resources.

Finally, **SDG 13 (Climate Action)** is unmet since local adaptive capability is still restrained by inadequate resources, incomplete extension coverage, and insufficient integration of climate information into planning processes. Without improved adaption efforts, climate threats will continue to jeopardise the other SDGs. Gender differences exacerbate these issues. Women in Biu LGA frequently bear disproportionate duty for water collection, food processing, and home care, increasing their susceptibility to climate-related pressures. Addressing these interconnected repercussions necessitates integrated, cross-sectoral actions rather than discrete sectoral responses.

7. Coping Strategies, Adaptation and Institutional Responses

Households in Biu LGA have devised a variety of coping and adaption mechanisms in response to climate stress. Crop diversification, early or staggered planting to capitalise on unpredictable rainfall onset, adoption of drought-tolerant crop types, mixed cropping, and livelihood diversification into petty trading or seasonal employment are all common practices. Social networks and informal mutual assistance systems can also help households deal with temporary disruptions. Evidence from local perception and adaptation research suggests that education and agricultural experience improve both the accuracy of climate perception and the effectiveness of actions. At the institutional level, numerous frameworks and programs have been implemented. The Climate-Smart Agriculture Investment Plan for Borno State prioritises funding for climate-smart techniques, agroforestry, land management, integrated livestock systems, and improved extension services, with the goal of reaching more than 1.2 million people. The Borno State Climate Resilience Action Plan establishes an overarching policy framework. Extension services and climate information programs, where available, assist farmers in changing planting schedules and implementing new practices. Despite these attempts, substantial limits remain. Many households do not have appropriate access to funds for improved seeds, irrigation, or other livelihoods. Infrastructure for water storage, small-scale irrigation, and rural roadways is still insufficient. Access to relevant technologies and timely climatic information varies, and

extension coverage is incomplete. These structural impediments limit the scope and effectiveness of both household and institutional adaptation responses, leaving many communities with only partial protection from escalating climate hazards.

8. **Conclusion**

This chapter has demonstrated that climate change represents a considerable and complex danger to human security and sustainable development in the Biu Local Government Area of Borno State. Existing data suggests an estimated increase of 1.5°C in mean temperature and an approximate 15% reduction in yearly precipitation in recent decades, including heightened rainfall fluctuations, abbreviated growth periods, and a spike in drought occurrences. These climate patterns have compromised various aspects of human security. Food security is undermined by diminished yields; water security is challenged by periodic shortages; health security is influenced by thermal stress, disease threats, and nutritional deficiencies; economic and livelihood security is diminished by falling agricultural revenues; environmental security is jeopardised by soil degradation and loss of flora; and community security is pressured by competition for resources and population movement. The resultant pressures hinder advancement toward critical Sustainable Development Goals, specifically SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 3 (Good Health and Well-being), SDG 6 (Clean Water and Sanitation), and SDG 13 (Climate Action). Despite households utilising diverse indigenous adaption methods, these efforts are inadequate due to poor institutional backing, financial limitations, and infrastructural deficiencies. Tackling these interrelated issues necessitates cohesive, human-focused, and climate-resilient strategies that enhance adaptive capacity, bolster environmental governance, and broaden sustainable livelihood prospects for at-risk communities in Biu LGA and comparable semi-arid regions.

9. **Recommendations**

Based on the findings, the study recommends that:

i. Promote climate-smart agriculture in Biu LGA through the wider adoption of drought-tolerant seed varieties, conservation agriculture, agroforestry, and sustainable land management practices.

ii. Improve water management systems by expanding rainwater harvesting, protecting watersheds, and supporting small-scale irrigation infrastructure.

iii. Expand climate information services and early-warning systems so that farmers receive timely, locally relevant forecasts and advisories.

iv. Strengthen agricultural extension programmes to ensure broader coverage, practical demonstration of climate-resilient techniques, and continuous farmer support.

v. Integrate climate adaptation systematically into local development planning and budgeting at both the Biu Local Government and Borno State levels.

vi. Encourage continuous local climate monitoring and research, including collaboration with institutions such as the Nigerian Army University Biu, to generate high-resolution data for evidence-based decision-making.

References

Al, W., Orking, G., & Clima, O. (2008). Climate change and food security: a framework document. *FAO Rome*, *3*.

Atedhor, G. O., Odjugo, P. A. O., and colleagues. (2021). *Systematic review of climate change impact research in Nigeria: Implication for sustainable development*. *SN Applied Sciences*.

Commission on Human Security. (2003). *Human security now*. United Nations.

Dutse, A. I. (2024). *Nexus between climate change, conflict and human security in Nigeria*. *Nnamdi Azikiwe Journal of Political Science*, *9*(1), 40–53.

Federal Ministry of Environment. (2021). *National Climate Change Policy for Nigeria (2021–2030).* Federal Ministry of Environment, Abuja.

Intergovernmental Panel on Climate Change. (2022). *Climate change 2022: Impacts, adaptation and vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge University Press.

Intergovernmental Panel on Climate Change. (2023). *Climate change 2023: Synthesis report. Contribution of Working Groups I, II and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change*. IPCC.

Olanrewaju, C. C., & Joshua, S. (2022). *The impact of climate change on food and human security in Nigeria*. *International Journal of Climate Change Strategies and Management*, *14*(2), 148–167.

Sachs, J. D. (2015). *The age of sustainable development*. Columbia University Press.

United Nations Development Programme. (1994). *Human development report 1994: New dimensions of human security*. Oxford University Press.

United Nations Development Programme. (1994). *Human Development Report 1994: New Dimensions of Human Security.* Oxford University Press.

United Nations. (2015). *Transforming our world: The 2030 Agenda for Sustainable Development*. United Nations.

United Nations. (2023). *The Sustainable Development Goals Report 2023.* United Nations.

Wakdok, S. S., & Bleischwitz, R. (2021). Climate change, security, and the resource nexus: Case study of Northern Nigeria and Lake Chad. *Sustainability, 13*(19), 10734. https://doi.org/10.3390/su131910734

World Commission on Environment and Development (WCED). (1987). *Our common future*. Oxford University Press.

Page, M. J., McKenzie, J. E., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., et al. (2021). The PRISMA 2020 statement: An updated guideline for reporting systematic reviews. *BMJ, 372*, n71. https://doi.org/10.1136/bmj.n71

Snyder, H. (2019). Literature review as a research methodology: An overview and guidelines. *Journal of Business Research, 104*, 333–339.

Sukhera, J. (2022). Narrative reviews: Flexible, rigorous, and practical. *Journal of Graduate Medical Education, 14*(4), 414–417.

Atkinson, L. Z., & Cipriani, A. (2015). Reporting guidelines for literature searches and inclusion criteria in research syntheses. *Research Synthesis Methods, 6*(2), 165–174.