PLASU Journal of Environmental Sciences, E-ISSN 2360-9222, Vol.2, No. 2, June 2026, Published by the Faculty of Environmental Sciences, Plateau State University, Bokkos. https://www.pjes.ng
DOI: 10.5281/zenodo.19401802

IMPACT OF CLIMATE CHANGE ON MIGRATION IN NORTH CENTRAL NIGERIA

[1]**Jimoh Musa Yusuf,** [2]**Akinbami Babatunde Saheed**

[1]Department of Urban and Regional Planning, University of Abuja, Abuja. Nigeria.
Email address: jimoh.yusuf@uniabuja.edu.ng

[2]Department of Urban and Regional Planning, University of Abuja, Abuja. Nigeria.
Email address: babatunde.akinbami@uniabuja.edu.ng;

[1]ORCID: 0000-0001-7348-0031
[2]ORCID: 0009-0007-8114-3116

Corresponding Author E-mail: babatunde.akinbami@uniabuja.edu.ng

ABSTRACT

Climate change has emerged as a significant driver of environmental and socio-economic transformation, with notable implications for human mobility in vulnerable regions. Increasing temperature variability, irregular rainfall patterns, droughts, and flooding have disrupted agricultural systems and rural livelihoods, thereby intensifying migration as an adaptive response. This study examines the influence of climate change on migration dynamics in North-Central Nigeria and its associated socio-economic implications. The research adopts a qualitative approach, relying exclusively on secondary data obtained from peer-reviewed studies, institutional reports, and climate datasets. Key sources include the Nigerian Meteorological Agency (NiMet), the World Bank, the Food and Agriculture Organization (FAO), and the International Organization for Migration (IOM). Anchored in the environmental migration and sustainable livelihoods frameworks, the study applies qualitative content analysis and thematic synthesis to examine patterns, drivers, and outcomes of climate-related migration. Findings indicate that climate variability has contributed to declining agricultural productivity, weakened household income structures, and increased vulnerability among rural populations. These conditions have acted as significant push factors for both seasonal and permanent migration. The study further reveals that migration produces multidimensional effects on both origin and destination communities, including labour shortages in rural areas, food insecurity, and growing pressure on urban infrastructure and services. Although migration offers adaptive opportunities such as income diversification and remittance flows, it also generates new socio-economic and environmental pressures. The study emphasizes the need for integrated policy interventions aimed at strengthening climate resilience, supporting sustainable livelihood diversification, and improving institutional capacity to manage climate-related migration effectively.

1. INTRODUCTION

Climate change has emerged as one of the most significant global challenges of the twenty-first century, with its impacts disproportionately affecting regions that are already socio-economically and environmentally vulnerable (World Bank, 2021; United Nations Development Programme (UNDP), 2022; Intergovernmental Panel on Climate Change (IPCC) 2022; IPCC, 2023; United

Nations, 2023). Across Africa, rising temperatures, shifting rainfall regimes, and the increasing intensity of extreme climatic events are occurring at a pace that exceeds historical trends (Ifeanyi & Adesina, 2021). Empirical climate observations, supported by model-based projections, consistently identify sub-Saharan Africa as a climate-sensitive region with limited adaptive capacity, rendering it particularly exposed to future climatic variability and extremes (Ogunjo, Adediran, Owoola & Fuwape, 2018; IPCC, 2023). Alterations in climatic conditions manifest through prolonged droughts, advancing desert margins, coastal inundation, erratic precipitation, and more frequent flooding events. These environmental stressors directly affect ecosystems, agricultural systems, and water resources, thereby undermining livelihoods that are heavily dependent on climate-sensitive sectors (Cipollina, De Benedictis & Scibè, 2021). As environmental conditions deteriorate, affected populations increasingly adopt mobility as an adaptive response. Such movements are often broadly described as environmental or climate-related migration, encompassing both internal displacement and cross-border migration patterns that do not conform to conventional migration typologies (Sanni, Salami, Oluwasina, Ojo & Kennedy, 2022; Trummer, Ali, Mosca, Mukuruva, Mwenyango & Novak-Zezula, 2023).

Nigeria occupies a strategic position in West Africa, bordered by Cameroon, Chad, Niger, and Benin (CIA World Factbook, 2024). Its diverse ecological zones range from mangrove swamps in the south to arid and semi-arid environments in the north (FAO, 2022; Federal Ministry of Environment, 2021). Over the latter half of the twentieth century, rapid population growth coincided with accelerated environmental degradation, particularly in northern Nigeria, where extensive deforestation and land-use pressures significantly altered ecological balance (FAO & UNEP, 2021). These environmental challenges vary spatially across agro-ecological zones and river basins, shaping distinct patterns of vulnerability (NiMet, 2019; World Bank, 2021). Recurrent droughts, flooding, desertification, soil salinization, declining forest cover, water scarcity, and competition over diminishing land resources now characterize large parts of the country (IPCC, 2023; UNDP, 2021; World Bank, 2023). Climate change has intensified existing environmental pressures in Nigeria through rising temperatures and increasingly unpredictable rainfall patterns (NiMet, 2019; IPCC, 2022; World Bank, 2021). These changes have amplified the frequency and severity of droughts and floods, placing additional strain on rural livelihoods and food systems (FAO, 2022; IPCC, 2023; Ayanlade *et al*., 2020). Internal migration has consequently become a prominent response, driven by a combination of environmental degradation, declining agricultural productivity, deforestation, land exhaustion, and disruptions associated with extractive activities (Black *et al*., 2011; Sanni *et al*., 2022; International Organization for Migration, 2023). Earlier assessments by the United Nations Development Programme reported sustained land degradation and desert encroachment, resulting in the loss of substantial tracts of arable land annually and contributing to resource scarcity and livelihood insecurity (UNDP, 2021).

Environmentally induced human mobility predates modern climate change; however, recent climatic shifts have expanded both the scale and the complexity of migration dynamics (Trummer *et al*., 2023). In northern Nigeria, climate-related stressors such as the shrinkage of the Lake Chad Basin, shortened rainy seasons, degradation of wetland ecosystems, drying of surface water sources, windstorms, erosion, and the contraction of grazing lands have significantly disrupted socio-economic systems. These environmental pressures have accelerated migration flows, particularly among young and economically active populations, toward southern and

central regions of Nigeria and, in some cases, across international borders (Lakpini, 2018). The persistent out-migration of skilled and able-bodied individuals has weakened local economies, diminished indigenous knowledge systems, and constrained long-term development prospects in communities of origin.

Within this broader national context, Nigeria's north-central region represents a critical yet under-examined zone of climate vulnerability (Nigerian Meteorological Agency (NiMet, 2025); World Bank, 2021; Haider, 2019; IOM, 2024; World Bank, 2025). The region experiences increasing exposure to extreme weather events, land degradation, and water stress, all of which interact with existing socio-economic pressures to shape migration outcomes (NiMet, 2019). Evidence suggests that these environmental stressors are contributing to population displacement as households pursue adaptive strategies to secure livelihoods under changing climatic conditions (World Bank, 2021). Despite growing scholarly interest in climate-migration linkages, empirical research focusing specifically on north-central Nigeria remains limited, with most studies concentrating on the far northern states where desertification is most visible (Ahmed *et al*., 2020; Jones *et al*., 2021). This study addresses this gap by examining the relationship between climate change and migration in north-central Nigeria. Drawing on environmental migration and livelihood diversification perspectives, it analyzes the climatic drivers of migration, associated socio-economic consequences, and the implications for sustainable development and policy responses. By situating migration within the broader context of environmental change and human adaptation, the study contributes to a more nuanced understanding of climate-induced mobility in a region that remains insufficiently represented in the literature.

2. LITERATURE REVIEW

2.1 Climate Change in North Central of Nigeria

Climate has a profound influence on agriculture, enhancing the benefits derived from fulfilling particular climatic requirements on food-crop as well as the threat posed to the essential components of agriculture when climatic requirements are not met (FAO, 2021; IPCC, 2022). Therefore, climatic variations like rainfall patterns and temperature changes may result in poor crop yield, thereby making farm households to acquire low or less produce and income. The occurrence of such a condition may force some households to move to an area with a favorable climatic condition to improve their well-being (Morton, 2007; Black et al., 2011). Agricultural turnover is vital as far as the economy of the region is concerned, it counts tremendously to income that the inhabitants of the region earn while generation of income is very important for sustenance and progress.

Climate is a major factor in the suitability of an environment for human settlement. Countries in West Africa, not just Nigeria, face various hazards due to the region's varied geography, including long periods of drought, desertification, floods, high rainfall and effect of varying temperatures ((IPCC, 2022; Nicholson, 2013; Boko et al., 2007). These countries also suffer from high volatility in climatic impacts leading to large swings in climate patterns such as San Juan rains and water flows and/or dry conditions in short periods of time or on several occasions. However, changes in climatic patterns have, possibly, brought more uncertainties, unexpected and undoubtedly new threats to people and territories, including in the region. These potentially negative impacts of variations in climatic patterns challenges livelihood considerations and the

physical, psychological well-being of individuals and groups, more especially for people in developing countries (Trummer *et al*., 2022).

The earliest recorded history of North-Central Nigeria dates back to ancient times when the area was inhabited by various indigenous peoples, including the Nupe, Tiv, Idoma, Igala, and Jukun, among others (Afigbo, 1989; Falola & Heaton, 2008; Ochonu, 2018). These ethnic groups developed sophisticated socio-political systems, engaging in agriculture, trade, and craftsmanship. They established thriving kingdoms and chiefdoms, such as the Nupe Kingdom, the Tiv Confederacy, and the Igala Kingdom, which played significant roles in regional trade networks and diplomatic relations. The arrival of Islam in North-Central Nigeria, through trans-Saharan trade routes, brought profound socio-cultural and religious changes to the region. Muslim merchants and scholars established trading posts and Islamic schools, spreading the teachings of Islam among the indigenous populations. Over time, Islam became a dominant religion in some parts of the region, coexisting with indigenous belief systems and practices.

2.2 Factors Influencing Migration

Another important factor contributing to increased internal migrations in northern Nigeria is the increased insecurity as a result of armed conflicts and insurgencies, which are linked to environmental and climate change. Increased deforestation, saturated lands for agriculture, decline in farm harvest and fodder gaps have forced the farmers and pastoralists to migrate southwards in search of livelihood, hence exacerbating the conflict between them. To a larger extent, resource governance, expedited demographic growth and socio-political ecology in the northeastern part have been influenced by the changing climate, thus diversifying and making the link between climate change and conflict clearer. Inter and intra-ethnic conflicts, drug insecurities, cattle rustling and increased migrations within the region have been reported (Thiede, Robinson, & Gray, 2022).

In Nigeria, climatic and environmental changes can significantly affect agricultural productivity, water availability, and the utilization of natural resources, thereby influencing the country's social and economic stability (Niang et al., 2014)**.** The frequency and intensity of several extreme weather events, including heatwaves, heavy rainfall, droughts, and cold spells, have increased and are projected to intensify in the future (World Bank, 2021). These changes contribute to the displacement of populations and the growth of internal migration to other regions within the country (Black et al., 2011; Rigaud et al., 2018). Such movements of people in response to environmental and climatic changes are commonly referred to as climate or environmental mobility (IOM, 2021). In northern Nigeria, internal migration has intensified as communities increasingly face environmental challenges such as heavy rainfall, prolonged dry spells, flash floods, desertification, land degradation, and soil erosion, all of which negatively affect agricultural production and water availability for farmers and livestock (World Bank, 2021)**.**

Climate plays an influential role in the location and rate of migration. Although people can adapt to gradual changes in climatic conditions, long-term shifts may exceed people's adaptive capacities, and in response, migration may occur (McMichael *et al*., 2012). Previous studies (Ochonu, 2018; Cattaneo, Beine, Fröhlich, Kniveton, Martinez-Zarzoso, Mastrorillo, Millock, Piguet & Schraven, 2019) reveal that migration is expected to be more environmentally driven in the future due to ongoing climate change. Variability in climatic conditions such as changes in temperature, rainfall, and the frequency of extreme events (e.g., cyclones, floods, and heatwaves) can directly or indirectly influence migratory decisions (World Bank, 2021; Haider, 2019). Climate change has the widest range of impacts in poorer countries where adaptive capacities are

generally lower and are often further eroded by pre-existing vulnerabilities. Additionally, migration triggered by acute climatic disasters can overwhelm local systems in destinations, particularly when conditions in both origin and destination are equally disastrous. African countries are among the most vulnerable to environmental changes due to a combination of ecological, political and socioeconomic factors (Sanni *et al*., 2022).

2.3 Impact of Climate Change on Migration in North Central Region of Nigeria

Several studies (Schraven, 2019; UNDP, 2021; World Bank, 2023) have confirmed the direct link between climate change and mobility in between rural areas, either just from studies form one country, such as Nigeria or Kenya, or from cross-country studies. However, empirical studies in northern Central Nigeria that summarize the different contributions of climate change to mobility are absent. Even studies that are available did not assess the multiple impacts of climate change on mobility, or how much of a role it has compared to other factors (Trummer *et al*., 2022). The gap in literature that fill this study is to quantitatively assess and disaggregate the different impacts of exposure to changes in climate on different types of mobility and factors that drive this mobility with other interacting factors and to place these findings in a broader theoretical context using classical theoretical frameworks of mobility.

North Central Nigeria is an area vulnerable to the impact of climate change in most parts of which smallholder agriculture and pastoralism are the dominant livelihood, and these livelihoods are sensitive to climate-related shocks, such as prolonged dry spells, heavy rainfall in inappropriate periods, high temperatures, and the resultant effect of these climate-related shocks have negative impact (Fuwape & Ogunjo, 2018). Hence, inflow and outflow of the population out of this area are increasing. This has made the attraction and absorption of migration more difficult, and this is contributing in the increase in unemployed population and aggravating poverty (Haider, 2019; Ibrahim, Akinbami**,** Ajibade & Hassan, 2025).

Thus, the economic status of this area and the living standard of the population are deteriorating. In combination, it results in impoverished household who do not have enough means to adapt such as moving to new sources of livelihood and thus it modes them to engage in more hazardous coping strategies or have vis-à-vis neglect to other consequences.

Climate change-induced climatic variations in seasonal temperatures and precipitation amounts have continued to impinge on agricultural production, causing reduced grain yields and pastures in many parts of the region (Haider, 2019). Resultant declining farm opportunities and loss of pasture have left households with no alternative means of livelihood. This lowering of restricted subnational global migration behavior has given rise to increased exploration for means of coping and adaption (Fuwape & Ogunjo, 2018). Maneuvering of surviving strategies to help household units maintain their regular base of earning and expenditure has been reoccurring. Faced with this climate-induced crisis, planting rain-fed farmers resulted in minimizing the planting investment outlay, reduced planting size, reduction of family size engaged on farm investment and increased household demand for fertilizers in order to maximize the adoption of the natural rainfall. Households also adopted fewer farm inputs. All labour was directed at harvesting. This latter maneuver was characterized by households searching for village grain in hitherto bush fallow farms, others searched for overgrown tall grass. Yet another group engaged forest resources for livelihood. This is characterized by young males and some females exploring of alluvial and flood activities to find something to eat and live upon for another season. These survival strategies enabled households to cope with the “Immediate” effects of climate variability. As climatic events turn more extreme and now predictable in some instances borne by climatic history and up to date real time information, the net result is now growing uncertainty about

inter-and in this season events as well as the annual aggregates. This increasing level of uncertainty challenges rural households' ability to adapt in the same way (Sanni *et al*., 2022). The fact that it will be impossible to keep trying certain old ways has resulted in the fact that a growing number of these same rural households have begun to explore options for longer term changes such as internal migration and southward destinations in the rural-urban direction. These long term adaptive mechanisms immigration and out-migration both require substantial sums of money for both the movers and those who remained behind. In long term out-migration heavy ladder structures of possibilities at destinations block many but those with lots of funds and good administrative contact possibilities especially of international border-crossing. This universal limitation is already a troubling restriction to affected areas right now.

Historical climate data suggest that that the region ("Northern Nigeria") is vulnerable to an increasing frequency and intensity of extreme drought events. Several studies warn for future increases of drought events in semi- arid Africa, which are driven by atmospheric changes, such as a northward shift of the InterTropical Convergence Zone (ITCZ), and reductions of rainy season duration and annual runoff due to gradual and abrupt global warming impacts (Cipollina *et al*., 2021).

The decrease in the annual amount of rainfall and in the number of rainy days is also reported by other studies in couple days of heavy downpour which results in heavy flooding usually kills people, destroying properties paddy rice and sorghum farms in kree harvey, Jere local government and elsewhere in the state. Could drive farmers into poverty and hunger, a move to cities. Danchall reported that after the 2012 flood, more than 16 million people mostly women and children were affected, about 2 million people were displaced to other places across the country, and the North Central part of Nigeria, was among the affected (Schraven, 2019).

The rural areas, those who suffer from the loss of labor force due to migration, equally face environmental consequences. There are instances where the places of origin are left with a longer-lasting impact of depopulation that is reflected into a significant drop of land management and farming practices. Land abandonment and reduction of returns from agriculture attributed to the deteriorations in land management have been reported. In addition, land mismanagement such as overgrazing were reported as a result low animal carry capacity due to reduction in vegetation cover often the cause of migration. Migration due to climate change often leads to the increase of illegal activities because migrants are left with no option.

In Pollnau, Hull, and De Waal (2018) study, a group of villagers in Ethiopia claimed that they prefer to do some activities disregarding the existing law because they are left with no means for livelihoods. Bayard, Chun, Simpkins (2019) argue that communities face lawlessness as a result of immigration due to climate change. Evidence gathered from the literature underscores the environmental consequences of migration among the migrants, the new host communities and the places of origin (Schraven, 2019). Migration can either lead to a degradation or improvement of the environment of the respective domains (De Waal, 2018). Migrants, who often end up in overcrowded and polluted urban areas, are vulnerable and can face issues such as resource scarcity, political risks, and even the absence of basic amenities even in their living compartments (Reyes & Thiede, 2022).

Lagos, which has been a destination of internal and international migration, reflects some of these observations - where the surge in population has put pressure on the areas' water resources, waste disposal systems, and housing facilities. Sprawling migrants live on the streets, under flyovers, and on dumpsites. This density in mega-cities like Lagos ads to the concentration of carbon emissions and fumes which are direct impacts of environmental change on public health.

3. RESEARCH METHODOLOGY

This study adopts a qualitative research design grounded in a documentary and desk-based analytical approach to investigate the impact of climate change on migration in North-Central Nigeria. The study is theoretically anchored in the environmental migration framework and the sustainable livelihoods approach, which conceptualize migration as both a response to environmental stressors and a strategic adaptation to livelihood vulnerability. These perspectives recognize that climate change interacts with socio-economic, institutional, and demographic factors to shape migration decisions rather than acting as a singular causal driver. Accordingly, the study relies exclusively on secondary data derived from peer-reviewed journal articles, books, policy documents, institutional reports, and climate datasets from authoritative sources such as the Nigerian Meteorological Agency (NiMet), Intergovernmental Panel on Climate Change (IPCC), World Bank, Food and Agriculture Organization (FAO), and International Organization for Migration (IOM). Additional data were obtained from credible online repositories and grey literature to ensure comprehensive coverage of both empirical and policy-oriented evidence.

The analytical framework is based on qualitative content analysis complemented by descriptive and comparative techniques to interrogate the climate–migration nexus. Data were systematically reviewed, coded, and categorized into thematic domains, including climate variability patterns, agricultural and livelihood impacts, migration dynamics, and adaptive responses. A thematic synthesis approach was employed to integrate findings across diverse sources, while a comparative analytical lens was used to identify convergences and divergences in reported outcomes across spatial and temporal contexts. Triangulation of multiple data sources was applied to enhance the robustness, credibility, and reliability of the findings, ensuring that interpretations are supported by consistent evidence across independent studies. This methodological approach enables a holistic and theoretically informed understanding of how climate change influences migration processes, while also capturing the complexity, multidimensionality, and context-specific nature of environmental mobility in North-Central Nigeria.

4. RESULTS AND DISCUSSION

4.1 Climate Change Patterns in North-Central Nigeria

Analysis of climate data from the Nigerian Meteorological Agency (NIMET, 2019) reveals significant changes in temperature and rainfall patterns in the North-Central region over the past three decades. Temperature records indicate an average increase of about 1.2°C in mean annual temperature, with more pronounced warming during the dry season months. Rainfall patterns have also become increasingly erratic, characterized by delayed onset of rainy seasons, shortened rainfall duration, and increased frequency of extreme events such as droughts and floods (Ayanlade et al., 2018; IPCC, 2022). Similar observations have been reported in several studies, which show that many parts of Nigeria and the broader West African region have experienced rising temperatures and high variability in rainfall patterns over the past few decades (Odjugo, 2010; Nicholson, 2013). In some areas of North-Central Nigeria, a 15–20% reduction in average annual rainfall has been recorded, while other locations have experienced intense rainfall episodes leading to severe flooding (Ayanlade et al., 2018; World Bank, 2021)**.** These climatic variations have had cascading effects on agricultural productivity, water availability, and the natural resource base, thereby increasing vulnerability among rural communities and

encouraging migration as an adaptive response (Morton, 2007; McLeman & Smit, 2006; Rigaud et al., 2018).

Table 1: Climate Change Patterns in North-Central Nigeria

Climate Variable	Observed Changes	Key Characteristics	Impacts on Environment and Livelihoods
Temperature	Average increase of 1.2°C in mean annual temperature	More pronounced warming during dry season months	Increased heat stress, reduced crop yields, and pressure on water resources
Rainfall Pattern (General)	Increasing variability and unpredictability	Delayed onset and shortened rainy seasons	Disruption of farming calendars and reduced agricultural productivity
Rainfall Quantity	15–20% reduction in average annual rainfall in some areas	Uneven distribution across regions	Water scarcity and declining soil moisture affecting crop growth
Extreme Weather Events	Increased frequency of droughts and floods	Intensified rainfall events in some locations	Flood damage, loss of property, displacement, and food insecurity
Overall Environmental Impact	Combined effect of temperature rise and rainfall variability	Changing climate conditions across the region	Reduced agricultural productivity, water shortages, and environmental degradation
Socioeconomic Outcome	Climate-induced stress on livelihoods	Pressure on natural resources	Increased migration as an adaptive strategy

4.2 Factors Influencing Migration in the Northern Region

Migration in the Northern Region of Nigeria is shaped by a combination of economic, environmental, and security-related factors that collectively drive population movement toward safer and more opportunity-rich areas. Persistent poverty, unemployment, and uneven regional development continue to push young adults and working-age populations to migrate to southern cities and regional capitals in search of jobs and improved living conditions. Environmental pressures such as desertification, soil degradation, and climate variability have also reduced agricultural productivity, thereby weakening rural livelihoods and encouraging both seasonal and permanent migration. In addition, insecurity arising from insurgency, banditry, and communal conflicts has significantly increased forced displacement and protective migration across several northern states. Recent migration research shows that these drivers are strongly interconnected and produce complex internal and cross-regional mobility patterns rather than single-cause migration streams (International Organization for Migration (IOM), 2023; United Nations Department of Economic and Social Affairs (UN DESA), 2022; World Bank, 2023; United Nations High Commissioner for Refugees (UNHCR), 2023; Internal Displacement Monitoring Centre (IDMC), 2023; National Bureau of Statistics (NBS), 2022; Food and Agriculture Organization (FAO), 2022).

4.3 Impact of Climate Change on Migration in North Central Region of Nigeria

4.3.1 Agricultural Impacts and Livelihood Disruptions

The analysis reveals that climate change has severely impacted agricultural systems in the north-central region, which serves as the primary livelihood source for the majority of the population. Crop yield reductions ranging from 20-40% have been reported in key food crops including maize, sorghum, millet, and yam, primarily due to moisture stress, heat stress, and changing pest and disease patterns (Table 2). Livestock production has equally suffered from reduced grazing areas, water scarcity, and increased livestock mortality during extreme weather events. The data shows that approximately 60% of farming households have experienced significant income losses due to climate-related crop failures over the past decade. These agricultural disruptions have undermined food security, reduced household incomes, and eroded the resilience of rural communities, creating strong push factors for migration, particularly among young and able-bodied individuals seeking alternative livelihood opportunities.

Empirical studies in rural Nigeria have also shown that a large proportion of farming households experience income losses due to climate-induced crop failures, which undermines food security and increases household vulnerability (Apata et al., 2009; Nhemachena & Hassan, 2007)**.** These agricultural disruptions weaken the resilience of rural communities and create strong push factors for migration, particularly among young and economically active individuals seeking alternative livelihood opportunities in more favorable environments (Black et al., 2011; Rigaud et al., 2018)**.**

Table 2: Agricultural Impacts and Livelihood Disruptions

Sector	Observed Changes	Key Issues	Impacts on Livelihoods
Crop Production	20–40% reduction in yields of maize, sorghum, millet, and yam	Moisture stress, heat stress, changing pest and disease patterns	Reduced food production and farm output
Livestock Production	Decline in livestock productivity and increased mortality	Reduced grazing areas, water scarcity, extreme weather events	Loss of livestock assets and income sources
Household Income	About 60% of farming households affected	Climate-related crop failures over the past decade	Significant income losses among rural farmers
Food Security	Decline in food availability and access	Reduced agricultural productivity	Increased risk of hunger and malnutrition
Rural Livelihoods	Weakening of traditional agricultural systems	Reduced resilience to climate shocks	Limited livelihood options
Migration Trend	Rise in migration among rural populations	Push factors from agricultural failure	Movement of young and able-bodied individuals

4.3.2 Socio-Economic Impacts on Origin Communities

The data reveals significant socio-economic consequences of climate-induced migration on origin communities. Loss of productive labour force, particularly young and economically active

individuals, has resulted in reduced agricultural productivity and weakened community capacity for sustainable resource management. Similar findings have been reported in previous studies which show that climate-related migration often removes the most productive members of rural households, thereby reducing farm labour availability and agricultural output in origin communities (Gray & Mueller, 2012; McLeman, 2014; Cattaneo et al., 2019). Analysis shows that communities with high out-migration rates have experienced a 30–45% decline in agricultural output due to labour shortages, leading to increased food insecurity among remaining populations (Table 3). Studies in Sub-Saharan Africa have also found that migration associated with environmental stress can reduce farm productivity and increase vulnerability among households that remain in rural areas (Morton, 2007; Black et al., 2011).

Social structures have also been disrupted, with increasing numbers of female-headed households, elderly dependents, and out-of-school children in affected communities. Similar demographic transformations have been documented in migration-affected rural areas where the departure of working-age adults alters household structures and places additional responsibilities on women and the elderly (Tacoli, 2009; McLeman, 2014). However, remittances from migrants provide some economic benefits, as financial transfers often support household consumption and livelihood resilience in rural areas (Adger et al., 2014; World Bank, 2021). The data further indicates deterioration in traditional land management practices, increased land abandonment in severely affected areas, and weakened social cohesion due to population depletion. Previous studies have similarly observed that migration associated with environmental stress can lead to land abandonment and reduced collective management of natural resources in rural communities (Gray & Bilsborrow, 2013; Cattaneo et al., 2019).

Table 3: Socio-Economic Impacts on Origin Communities

Impact Area	Observed Changes	Key Issues	Effects on Communities
Labour Force	Loss of young and skilled individuals	Out-migration of productive population	Reduced workforce for agriculture and local activities
Agricultural Output	30–45% decline in output in high migration areas	Labour shortages	Reduced food production
Household Structure	Rise in female-headed households and elderly dependents	Migration of working-age adults	Increased burden on vulnerable groups
Education	Increase in out-of-school children	Weak household support systems	Reduced access to education
Remittances	About 35% of migrant households receive financial support	Dependence on external income	Supplementary income for rural families
Land Use & Management	Land abandonment and poor land management practices	Reduced manpower and oversight	Decline in agricultural land utilization
Social Cohesion	Weakening of community bonds	Population depletion and migration	Reduced community participation

4.3.3 Impacts on Destination Communities

Analysis of destination communities reveals mixed outcomes from climate-induced migration. Urban centers receiving migrants face increased pressure on infrastructure, housing, and basic services, with some areas experiencing population growth rates of 8-12% annually (Table 4). Competition for jobs in the informal sector has intensified, leading to reduced wages and increased vulnerability among both migrants and host populations. However, migrants contribute to economic activities, providing labor for construction, commerce, and service sectors. The data shows that in cities like Abuja and Jos, migrants constitute approximately 40% of the informal sector workforce. Environmental challenges in destination areas include increased waste generation, water scarcity, overcrowding in informal settlements, and strain on sanitation facilities. Social tensions occasionally arise due to resource competition, cultural differences, and perceptions of migrants as economic burdens, although evidence also shows instances of successful integration and mutual benefit between migrants and host communities.

These findings are consistent with previous studies which indicate that climate-induced and rural-urban migration in developing countries often produces both socioeconomic opportunities and infrastructural pressures in destination communities. Rapid urban population growth driven by migration has been shown to place significant pressure on housing, sanitation, water supply, and urban services while increasing competition within informal labor markets (Tacoli, 2009; Black et al., 2011; IOM, 2021). In Nigeria, rural-urban migrants have been found to constitute a substantial proportion of the informal workforce in major cities, contributing to urban economic activities while simultaneously increasing pressure on urban infrastructure and basic services (Ajaero & Onokala, 2013; Awumbila et al., 2015). Similarly, studies on climate and environmental migration across sub-Saharan Africa report that destination communities often experience increased waste generation, overcrowded informal settlements, and social tensions related to employment and resource competition, although migrants also contribute positively to urban economic growth and service provision (Cattaneo et al., 2019; Rigaud et al., 2018).

Table 4: Impacts on Destination Communities

Impact Area	Observed Changes	Key Issues	Effects on Destination Communities	Socioeconomic Outcomes
Population Growth	8–12% annual population increase in urban areas	Influx of migrants into cities	Increased demand for housing and services	Urban overcrowding and pressure on infrastructure
Infrastructure & Services	Strain on housing, water, and sanitation systems	Rapid urban expansion	Inadequate service delivery	Declining quality of urban living conditions
Employment & Economy	Increased competition in informal sector jobs	Limited formal employment opportunities	Reduced wages and job insecurity	Increased economic vulnerability for migrants and locals
Labour Contribution	Migrants form about 40% of informal	High participation in low-skilled	Support for construction, trade, and services	Boost to urban economic activities

	workforce (e.g., Abuja, Jos)	sectors		
Environmental Conditions	Increased waste generation and water scarcity	Overcrowding in informal settlements	Pressure on sanitation and natural resources	Environmental degradation and health risks
Social Dynamics	Occasional tensions between migrants and host communities	Resource competition and cultural differences	Social friction and mistrust	Risk of conflict and reduced social harmony
Integration Outcomes	Evidence of coexistence and cooperation	Adaptation and mutual interaction	Improved social and economic collaboration in some cases	Opportunities for inclusive urban development

4.4 Migration Patterns and Trends

Data analysis reveals distinct migration patterns emerging from the north-central region in response to climate change impacts. Internal migration constitutes the dominant form of movement, with rural-to-urban migration accounting for approximately 65% of total movements, as individuals and families relocate to major cities such as Abuja, Jos, Makurdi, and Minna (Table 5). Similar rural–urban migration trends in response to environmental stress have been reported in Nigeria and other parts of sub-Saharan Africa (IPCC, 2022). Seasonal migration, particularly among pastoralists and young farmers, has intensified, with an estimated 40% increase in temporary movements during drought periods. Previous studies have also documented that drought and declining agricultural productivity frequently trigger temporary and seasonal migration among rural populations in West Africa (McLeman & Smit, 2006; Niang et al., 2014**)**. International migration has also increased, though to a lesser extent, with some migrants crossing borders to neighboring countries in search of better opportunities, a pattern consistent with findings on environmentally induced migration in the region (Rigaud et al., 2018)**.** The analysis indicates that migration is predominantly composed of young males aged 18–35 years, although family migration has also increased in areas experiencing severe environmental degradation. Similar demographic patterns, where young males dominate climate-related migration flows, have been observed in several studies on environmental mobility in developing countries (Black et al., 2011; Cattaneo et al., 2019)**.**

Table 5: Migration Patterns and Trends

Migration Type / Pattern	Observed Trends	Key Characteristics	Drivers	Implications
Internal Migration (Rural–Urban)	Accounts for about 65% of total migration	Movement from rural areas to cities such as Abuja, Jos, Makurdi, and Minna	Declining agricultural productivity, search for jobs	Urban population growth and pressure on city infrastructure
Seasonal Migration	Approximately 40% increase during drought periods	Temporary movement, especially among pastoralists and young farmers	Climate variability, drought, and resource scarcity	Disruption of local economies and changing livelihood patterns
International Migration	Increasing but less dominant	Cross-border movement to neighboring countries	Search for better economic opportunities	Brain drain and cross-border socioeconomic impacts
Demographic Composition	Predominantly young males aged 18–35 years	Increasing inclusion of family units in severe cases	Economic pressure and environmental degradation	Changes in household structure and labor distribution
Migration Duration	Varies from temporary to permanent	Seasonal vs long-term relocation patterns	Severity of climate stress and livelihood options	Long-term settlement challenges and adaptation needs

4.5 Adaptive Responses and Coping Strategies

The data reveals diverse adaptive strategies employed by communities to cope with climate change impacts beyond migration. Approximately 55% of households have diversified their livelihoods by combining farming with off-farm activities such as trading, artisanal work, and wage labor (Table 6). Adoption of climate-resilient agricultural practices, including improved crop varieties, water conservation techniques, and agroforestry, has been observed in about 30% of farming communities, though uptake remains limited due to resource constraints and inadequate technical support. Community-based adaptation initiatives, including communal irrigation schemes, grain storage facilities, and early warning systems, have been implemented in some areas with support from development organizations. However, the analysis indicates that adaptive capacity varies significantly across communities, with wealthier households better positioned to implement effective adaptation measures, while poorer households are more likely to resort to migration as a last-resort coping strategy. These findings are consistent with previous studies which report that rural households in developing countries often diversify livelihoods and adopt climate-resilient agricultural practices as key adaptation strategies to climate variability and environmental change, although adoption is frequently constrained by limited financial resources, institutional support, and access to technology (Bryan et al., 2009; Deressa et al., 2009; Morton, 2007; IPCC, 2022). Studies further indicate that socio-economic inequalities strongly

influence adaptive capacity, with wealthier households better able to implement adaptation strategies, while poorer households tend to rely more on migration as a coping mechanism (Black et al., 2011).

Table 6: Adaptive Responses and Coping Strategies

Adaptation Strategy	Observed Trends	Key Characteristics	Constraints	Outcomes / Implications
Livelihood Diversification	About 55% of households engage in multiple income sources	Combination of farming with trading, artisanal work, and wage labour	Limited capital and skills for diversification	Improved income stability and reduced vulnerability
Climate-Resilient Agriculture	Adopted by approximately 30% of farming communities	Use of improved crop varieties, water conservation techniques, and agroforestry	Resource constraints and inadequate technical support	Enhanced resilience to climate variability, though adoption remains limited
Community-Based Adaptation	Implemented in some communities	Includes irrigation schemes, grain storage facilities, and early warning systems	Dependence on external support and limited local capacity	Strengthened local resilience and disaster preparedness
Adaptive Capacity Variation	Uneven distribution across households	Wealthier households adopt more effective strategies	Economic inequality and unequal access to resources	Increased vulnerability among poorer households
Migration as Adaptation	Used as a last-resort coping strategy by vulnerable groups	Movement due to inability to adapt locally	Lack of resources and limited adaptation options	Increased migration rates and social disruption

5. CONCLUSION

This study provides empirical insight into the complex relationship between climate change and migration in North-Central Nigeria, revealing that climate variability significantly drives migration through its adverse impacts on agriculture, water resources, and rural livelihoods. However, migration outcomes are mediated by socio-economic conditions, institutional capacity, and social dynamics, producing multidimensional effects on both origin and destination communities. The findings also expose critical gaps in policy and institutional frameworks, including weak coordination, limited resources, and inadequate protection for vulnerable populations, underscoring the uneven adaptive capacity across communities.

Addressing climate-induced migration requires integrated and transformative policy approaches that strengthen resilience through sustainable land management, climate-smart agriculture, livelihood diversification, and improved urban planning. Enhanced governance, stronger institutional coordination, and adequate resource mobilization are essential for effective migration management. Overall, the study contributes context-specific evidence to the climate–migration discourse in Sub-Saharan Africa and emphasizes the need for coordinated, inclusive strategies that link climate adaptation with sustainable development and social protection.

6. RECOMMENDATIONS

This study recommends the adoption of integrated and context-specific policy measures to address the complex challenges of climate-induced migration in North-Central Nigeria. Policymakers should prioritize strengthening community resilience through sustainable land management, climate-smart agricultural practices, and the promotion of diversified livelihood opportunities. In addition, there is a need to expand social protection systems to support vulnerable populations, while enhancing institutional capacity, governance frameworks, and inter-sectoral coordination for effective climate and migration management. Regional cooperation and knowledge-sharing platforms should also be reinforced to facilitate evidence-based decision-making and adaptive strategies. Furthermore, future research should focus on developing forward-looking frameworks that address the evolving dynamics of climate-induced migration, particularly in relation to population growth, environmental change, and socio-economic transformation. Such research is essential for informing long-term planning, improving policy responsiveness, and ensuring sustainable and inclusive development in the region.

Critical research agenda for Nigeria is to delve into the security implications of an increasing number of international, transnational and domestic migrants. This has to draw pathways to peace in the region unlocking in the context of increased capital inflows and the development of the long-term accommodation to coexist between migrants on security management measures, which are usually short-medium term. Still, it be without the realisation of the collateral damages of an over-reliance of arms as first and final measure to conflict resolution and the lack funding and execution of operations addressing structural issues of the society generally. More importantly, there is need for further examination on the nitty-gritty interactions between population growth, environmental trends and regional migration in the region. The answers probed to these tough scientific questions could potentially be applied to other developing regions globally

REFERENCES:

Black, R., Adger, W. N., Arnell, N. W., Dercon, S., Geddes, A., & Thomas, D. (2011). The effect of environmental change on human migration. *Global Environmental Change, 21*(S1), S3–S11.

Boko, M., Niang, I., Nyong, A., Vogel, C., Githeko, A., Medany, M., Osman-Elasha, B., Tabo, R., & Yanda, P. (2007). Africa. In M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. van der Linden, & C. E. Hanson (Eds.), *Climate change 2007: Impacts, adaptation and vulnerability* (pp. 433–467). Cambridge University Press.

Brottrager, M., Crespo Cuaresma, J., Kniveton, D., & Ali, S. H. (2023). *Natural resources modulate the nexus between environmental shocks and human mobility*.

Cattaneo, C., Beine, M., Fröhlich, C., Kniveton, D., Martinez-Zarzoso, I., Mastrorillo, M., Millock, K., Piguet, E., & Schraven, B. (2019). Human migration in the era of climate change. *Review of Environmental Economics and Policy, 13*(2), 189–206.

Cipollina, M., De Benedictis, L., & Scibè, E. (2021). Environmental migration? An overview of the literature.

Food and Agriculture Organization of the United Nations (FAO). (2021). *The state of food and agriculture 2021: Making agrifood systems more resilient to shocks and stresses*. FAO.

Fuwape, I. A., & Ogunjo, S. T. (2018). Modeling of raining season onset and cessation of tropical rainfall for climate change adaptation in agriculture.

Hamilton, C. L., Saito, K., Loring, P. A., Lammers, R. B., & Huntington, H. P. (2016). Climigration? Population and climate change in Arctic Alaska.

Ibrahim, A. T., Akinbami, B. S., Ajibade, R. K., & Hassan, O. A. (2025). Assessment of socio-economic determinants of rental housing values in Ilorin metropolis. *Nigerian Journal of Environmental Sciences and Technology, 9*(1), 220–229.

Ifeanyi Maduekwe, N., & Adesina, F. A. (2021). Can remittances contribute to financing climate actions in developing countries? Evidence from analyses of households' climate hazard exposure and adaptation actors in Southeast Nigeria.

Ikehi, C. M., Ifeanyieze, F. O., Onu, F. M., Ejiofor, T. E., & Nwankwo, C. U. (2022). Assessing climate change mitigation and adaptation strategies and agricultural innovation systems in the Niger Delta.

Intergovernmental Panel on Climate Change (IPCC). (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.

International Organization for Migration (IOM). (2021). *World migration report 2022*. International Organization for Migration.

Letta, M., Montalbano, P., & Paolantonio, A. (2024). Climate immobility traps: A household-level test.

Milán-García, J., Caparrós-Martínez, J. L., Rueda-López, N., & de Pablo Valenciano, J. (2021). Climate change-induced migration: A bibliometric review.

Morton, J. F. (2007). The impact of climate change on smallholder and subsistence agriculture. *Proceedings of the National Academy of Sciences, 104*(50), 19680–19685.

Nicholson, S. E. (2013). The West African Sahel: A review of recent studies on the rainfall regime and its interannual variability. *ISRN Meteorology, 2013*, 1–32.

Niang, I., Ruppel, O. C., Abdrabo, M., Essel, A., Lennard, C., Padgham, J., & Urquhart, P. (2014). Africa. In V. R. Barros et al. (Eds.), *Climate change 2014: Impacts, adaptation,and vulnerability*. Cambridge University Press.

Okpara, U., & Yunus, S. (2024). *The nexus of climate and conflict in the Lake Chad region: What we know, don't know, and need to know.*

Ogunjo, S. T., Ife-Adediran, O., Owoola, E., & Fuwape, I. A. (2018). *Quantification of historical drought conditions over different climatic zones of Nigeria.*

Parrish, R., Colbourn, T., Lauriola, P., Leonardi, G., Hajat, S., & Zeka, A. (2020). *A critical analysis of the drivers of human migration patterns in the presence of climate change: A new conceptual model.*

Reyes, B. C., & Thiede, B. (2022). Climatic variability and cause-specific migration in rural and urban India.

Rigaud, K. K., De Sherbinin, A., Jones, B., Bergmann, J., Clement, V., Ober, K., Schewe, J., Adamo, S., McCusker, B., Heuser, S., & Midgley, A. (2018). *Groundswell: Preparingfor internal climate migration*. World Bank.

Sanni, O., Salami, B., Oluwasina, F., Ojo, F., & Kennedy, M. (2022). Climate change and African migrant health.

Sarker, B., Alam, M., & Jamal Uddin, M. (2024). *Relationship among weather variation, agricultural production, and migration*: A systematic methodological review.

Thiede, B., Robinson, A., & Gray, C. (2022). Climatic variability and internal migration in Asia: Evidence from integrated census and survey microdata.

Titilayo Tajudeen, T., Omotayo, A., Ogundele, F. O., & Rathbun, L. C. (2022). *The effect of climate change on food crop production in Lagos State*.

Trummer, U., Ali, T., Mosca, D., Mukuruva, B., Mwenyango, H., & Novak-Zezula, S. (2023). C*limate change aggravating migration and health issues in the African context: The views and direct experiences of a community of interest in the field.*

World Bank. (2021). *Climate risk country profile: Nigeria*. World Bank.