

# GROUNDSWELL AFRICA

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## A DEEP DIVE INTO **INTERNAL** **CLIMATE** **MIGRATION** **IN NIGERIA**

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# Glossary

**Adapt in Place:** The cost of relocation in response to actual or expected climate change and its effect can often be high. Adapt in place is the process of adjustment without relocation.

**Adaptation:** Process of adjustment to actual or expected climate change and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate change and its effects.

**Adaptive capacity:** Ability of systems, institutions, humans, and other organisms to adjust to potential damage, take advantage of opportunities, and respond to consequences of climate impacts.

**Agro-pastoralism:** Combination of agriculture, crop-based livelihood systems, and pastoralism (see also **pastoralism**).

**Anthropogenic biome:** Anthropogenic biomes describe the terrestrial biosphere in its contemporary, human-altered form using global ecosystem units defined by patterns of sustained direct human interactions, for example, rainfed croplands.

**Attractiveness:** Desirability of a locale based on several factors including but not limited to economic opportunity, transportation infrastructure, proximity to family, the presence of social amenities, environment, and intangibles such as place attachment.

**Biodiversity:** Variety of plant and animal life in the world or in a particular habitat or ecosystem.

**Biome:** Large naturally occurring community of flora and fauna occupying a major habitat (for example, forest or tundra; see also **anthropogenic biome**).

**Climate change:** A change in the state of the climate that can be identified (for example, using statistical tests) by changes in the mean and/or the variability of its properties, and that persists for an extended period, typically decades or longer. It refers to any change in climate over time, whether due to natural variability or because of human activity.

**Climate change-induced migration (shorthand internal climate migration):** In this report, climate change-induced migration is movement that occurs within countries that can be attributed largely to slow-onset impacts of climate change on livelihoods owing to shifts in water availability, crop and ecosystem productivity, flood risk, or sea level rise compounded by storm surge. The model also includes nonclimate factors: demographic factors (median age and sex) and conflict.

**Climate in-migration hotspot:** For the purposes of this study, climate in-migration hotspots are areas that will see increases in population in scenarios that take climate impacts into account relative to a population projection that does not take climate impacts into account. These increases can be attributed to in-migration, the “fast” demographic variable. Areas were considered to have increases in population when at least two of the three scenarios modelled had increases in population density in the highest 5th percentile of the distribution.

**Climate migrant/migration (shorthand internal climate migrant/migration):** In this report, climate migrants are people who move - within countries - because of climate change-induced migration (see above). The modeling work captures people who move at spatial scales of over 14 kilometers - within a country - and at decadal temporal scales. Shorter distance or shorter-term mobility (such as seasonal or cyclical migration) is not captured.

**Climate out-migration hotspot:** For the purposes of this study, climate out-migration hotspots are areas that will see decreases in population in scenarios that take climate impacts into account relative to a population projection that does not take climate impacts into account. These decreases can be attributed to out-migration, the “fast” demographic variable. Areas were considered to have decreases in population when at least two of the three scenarios modelled had decreases in population density in the highest 5th percentile of the distribution.

**Climate risk:** Potential for consequences from climate variability and change where something of value is at stake and the outcome is uncertain. Often represented as the probability that a hazardous event or trend occurs multiplied by the expected impact. Risk results from the interaction of vulnerability, exposure, and hazard.

**Coastal erosion:** Erosion of coastal landforms that results from wave action, exacerbated by storm surge and sea level rise.

**Coastal zone:** In this report, the coastal zone is land area within 5 kilometers of the coastline.

**Conflict:** Armed conflicts between groups. Armed Conflict Location & Event Data Project (ACLED) covers violent activity that occurs both within and outside the context of a civil war, particularly violence against civilians, militia interactions, communal conflict, and rioting.

**Country Partnership Framework (CPF):** Strategic document that guides the World Bank’s country programs. The CPF identifies the key objectives and development results through which the World Bank intends to support a member country in its efforts to end extreme poverty and boost shared prosperity in a sustainable manner.

**Crop productivity:** Crop yield in tons per hectare on an annual time step.

**Deforestation:** Conversion of forest to non-forest.

**Demographic dividend:** The potential for economic growth made possible from shifts in a population’s age structure.

**Disaster Risk Reduction:** The practice of reducing disaster risks through systematic efforts to analyse and reduce the causal factors of disasters.

**Displacement:** Forced removal of people or people obliged to flee from their places of habitual residence.

**Distress migration:** Movements from the usual place of residence, undertaken when an individual and their family perceive that there are no options open to them to survive with dignity, except to migrate. This may be a result of a rapid-onset climate event, other disasters, or conflict event, or a succession of such events, that result in the loss of assets and coping capacities.

**Environmental mobility:** Temporary or permanent mobility because of sudden or progressive changes in the environment that adversely affect living conditions, either within countries or across borders.

**Extreme heat event:** Three or more days of above-average temperatures, generally defined as passing a certain threshold (for example, above the 85th percentile for average daily temperature in a year).

**Extreme weather event:** Event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally fall in the 10th or 90th percentile of a probability density function estimated from observations. The characteristics of extreme weather vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classified as an extreme climate event, especially if it yields an average or total that is itself extreme (for example, drought or heavy rainfall over a season).

**Flood Risk:** The risk of inundation from flooding owing to extreme precipitation events, indicated in this modeling work by flood extent.

**Forced migration:** Forced migration generally implies a lack of volition concerning the decision to move, though in reality motives may be mixed, and the decision to move may include some degree of personal agency or volition.

**GEPIC:** The GIS-based Environmental Policy Integrated Climate crop model (see Appendix A of Rigaud et al. 2021a).

**Gravity model:** Model used to predict the degree of interaction between two places and the degree of influence a place has on the propensity of a population in other locations to move to it. It assumes that places that are larger or spatially proximate will exert more influence on the population of a location than places that are smaller and farther away.

**Gross domestic product (GDP):** The monetary value of all finished goods and services made within a country during a specific period.

**HadGEM2-ES:** Climate model developed by the Met Office Hadley Centre for Climate Change in the United Kingdom (see Appendix A of Rigaud et al. 2021a).

**Hazard:** The potential occurrence of a natural or human-induced physical event or trend or physical impact that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, ecosystems, and environmental resources.

**Immobility:** Inability to move from a place of risk or choosing not moving away from a place of risk.

**In-kind transfers:** Unlike a cash transfer, it refers to the specific goods and services that migrants send back home.

**Internal climate migrant (migration):** In this report, climate migrants are people who move within countries because of climate change-induced migration (see above). The modeling work captures people who move at spatial scales of over 14 kilometers within a country, and at decadal temporal scales. Shorter distance or shorter-term mobility (such as seasonal or cyclical migration) is not captured.

**Internal migration (migrant):** Internal migration is migration that occurs within national borders.

**International migration (migrant):** Migration that occurs across national borders.

**IPSL-CM5A-LR:** Climate model developed by the Institut Pierre Simon Laplace Climate Modeling Center in France (see Appendix A of Rigaud et al. 2021a).

**Labor mobility:** The geographical and occupational movement of workers.

**Land degradation:** The deterioration or decline of the biological or economic productive capacity of the land for present and future.

**Landscape approach:** An approach that advances multiple land uses and sustainable landscape management (SLM) to ensure equitable and sustainable use of land.

**LPJmL:** A global water and crop model designed by Potsdam Institute for Climate Impact Research to simulate vegetation composition and distribution as well as stocks and land-atmosphere exchange flows of carbon and water, for both natural and agricultural ecosystems.

**Median Age:** The age that divides a population into two numerically equal groups; that is, half the people are younger than this age and half are older.

**Micro-watershed management:** The management of land, water, biota, and other resources for ecological, social, and economic purposes with use of the micro-watershed as the unit of intervention (500-1000 ha).

**Migration:** Movement that requires a change in the place of usual residence and that is longer term. In demographic research and official statistics, it involves crossing a recognized political and administrative border.

**Migration cycle:** The three stages of migration process which can be leveraged for adaptation that is adapt in place, enable mobility and after migration support to host and migrant communities.

**Mitigation (of climate change):** Human intervention to reduce the sources or enhance the sinks of greenhouse gases.

**Mobility:** Movement of people, including temporary or long-term, short- or long-distance, voluntary, or forced, and seasonal or permanent movement as well as planned relocation (see also environmental mobility, labor mobility).

**Moderate development:** Shared Socioeconomic Pathway (SSPs) 2 scenario conceived by in O'Neill et al. 2014, in which developing countries achieve significant economic growth. Under an SSP2 scenario, lower-middle-income countries (LMICs) are characterized by moderate population growth, urbanization, income growth, and education; and have moderate challenges to adaptation.

**More inclusive development:** Scenario with SSP2 (moderate development) and Representative Concentration Pathway (RCP) 8.5 (high GHG emissions).

**Nationally Determined Contributions (NDCs):** The non-binding national plans by each country to reduce national emissions and adapt to the impacts of climate change enshrined in the Paris Agreement.

**Net Primary Productivity (NPP):** Measure of ecosystem productivity, that is, the productivity of a location's natural biome, including grassland biomes.

**Other internal migrant:** In this report, the term other migrant is used in reference to migrants who move largely for reasons other than climate impacts.

**Peri-urban:** An area immediately adjacent to a city or urban area.

**Planned relocation:** People moved or assisted to move permanently away from areas of environmental risks.

**Radiative forcing:** Measurement of capacity of a gas or other forcing agent to affect the energy balance, thereby contributing to climate change.

**Rainfed agriculture:** Agricultural practice relying almost entirely on rainfall as its source of water.

**Rapid-onset event:** Event such as cyclones and floods which take place in days or weeks (in contrast to slow-onset climate changes that occur over long periods of time).

**Representative Concentration Pathway (RCP):** Trajectory of greenhouse gas concentration resulting from human activity corresponding to a specific level of radiative forcing in 2100. The low greenhouse gas concentration RCP2.6 and the high greenhouse gas concentration RCP8.5 employed in this report imply futures in which radiative forcing of 2.6 and 8.5 watts per square meter, respectively, are achieved by the end of the century.

**Resilience:** Capacity of social, economic, and environmental systems to cope with a hazardous event, trend, or disturbance by responding or reorganizing in ways that maintain their essential function, identity, and structure while maintaining the capacity for adaptation, learning, and transformation.

**Riparian areas:** The lands that occur at the interface between terrestrial and aquatic ecosystems.

**Salinization:** The accumulation of water-soluble salts in the soil which leads to substantial negative impact on plant productivity.

**Sea level rise:** Increases in the height of the sea with respect to a specific point on land. Eustatic sea level rise is an increase in global average sea level brought about by an increase in the volume of the ocean due to the melting of land-based glaciers and ice sheets. Steric sea level rise is an increase in the height of the sea induced by changes in water density due to the heating of the ocean. Density changes induced by temperature changes only are called thermosteric; density changes induced by salinity changes are called halosteric.

**Sex Ratio:** The number of males per 100 females in the population.

**Shared Socioeconomic Pathway (SSP):** Scenarios, or plausible future worlds, that underpin climate change research and permits the integrated analysis of future climate impacts, vulnerabilities, adaptation, and mitigation. Shared Socioeconomic Pathways (SSPs) can be categorized by the degree to which they represent challenges to mitigation (greenhouse gas emissions reductions) and societal adaptation to climate change.

**Slow-onset climate change:** Changes in climate parameters (temperature, precipitation, and associated impacts, such as water availability and crop production declines) that occur over long periods of time—in contrast to rapid-onset climate hazards, such as cyclones and floods, which take place in days or weeks.

**Storm surge:** The rise in seawater level during a storm, measured according to the height of the water above the normal predicted astronomical tide.

**Stressor:** Event or trend that has important effect on the system exposed and can increase vulnerability to climate-related risk.

**Sustainable livelihood:** Livelihood that endures over time and is resilient to the impacts of various types of shocks including climatic and economic.

**Systematic Country Diagnostic (SCD):** World Bank tool to identify the most important challenges and opportunities a country faces in advancing towards the twin goals to end extreme poverty and boost shared prosperity in a sustainable manner.

**System dynamics model:** A model which decomposes a complex social or behavioral system into its constituent components and then integrates them into a whole that can be easily visualized and simulated.

**Tipping element:** Subsystems of the Earth system that are at least subcontinental in scale and can be switched—under certain circumstances—into a qualitatively different state by small perturbations. See tipping point.

**Tipping point:** Particular moment at which a component of the earth’s system enters into a qualitatively different mode of operation, as a result of a small perturbation.

**Transformation:** Strategies that can reduce the underlying causes of vulnerability to climate-induced migration.

**Urban transition:** Shift from rural to urban and from agricultural employment to industrial, commercial, or service employment.

**Vulnerability:** Propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts and elements including sensitivity or susceptibility to harm and lack of capacity to cope and adapt.

**Water Availability:** The water sector model outputs represent river discharge, measured in cubic meters per second in daily/monthly time increments.

**WaterGAP2:** The Water Global Assessment and Prognosis (WaterGAP) Version 2 global water model developed by the University of Kassel in Germany Germany (see Appendix A of Rigaud et al. 2021a).

# Abbreviations

<b>ACLED</b>	Armed Conflict Location & Event Data
<b>ACReSAL</b>	Agro-Climatic Resilience in Semi-Arid Landscapes
<b>AESZ</b>	Agro-Ecological Sub-Zonal
<b>CCDR</b>	Country Climate Development Report
<b>CIESIN</b>	Center for International Earth Science Information Network
<b>CMIP5</b>	Coupled Model Intercomparison Project phase 5
<b>COP24</b>	24th Conference of the Parties to the United Nations Framework Convention on Climate Change
<b>CPF</b>	Country Partnership Framework
<b>ECOWAS</b>	Economic Community of West African States
<b>ERGP</b>	Economic Recovery and Growth Plan
<b>GCM</b>	Global climate model
<b>GDP</b>	Gross domestic product
<b>GHG</b>	Greenhouse gas
<b>GRID</b>	Global Report on Internal Displacement
<b>HDI</b>	Human Development Index
<b>ICT</b>	information and communications technology
<b>ICZM</b>	Integrated Coastal Zone Management
<b>IDP</b>	Internally displaced person
<b>IOM</b>	International Organization for Migration
<b>IPCC</b>	Intergovernmental Panel on Climate Change
<b>ISIMIP</b>	Intersectoral Impacts Model Intercomparison Project
<b>LECZ</b>	Low Elevation Coastal Zone
<b>LIC</b>	Low-income country
<b>LMIC</b>	lower-middle-income country
<b>MIC</b>	Middle-income country
<b>MCP</b>	Maximum Catch Potential
<b>NASPA-CCN</b>	National Adaptation Strategy and Plan of Action on Climate Change
<b>NEWMAP</b>	Nigeria Erosion and Watershed Management Project
<b>NDC</b>	Nationally Determined Contribution
<b>NPC</b>	National Population Commission
<b>NPP</b>	Net primary productivity
<b>RCP</b>	Representative Concentration Pathway
<b>SCD</b>	Systematic Country Diagnostic
<b>SDG</b>	Sustainable Development Goal
<b>SSP</b>	Shared Socioeconomic Pathway
<b>WACA</b>	West Africa Coastal Areas



Joshua Oluwagbemiga / Unsplash

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# Foreword

Almost every fifth person in Sub-Saharan Africa is Nigerian, making Nigeria the most populous country on the continent, with a large and growing young population. At the same time, Nigeria is vulnerable to the consequences of a warming planet, for example due to agriculture being a key sector of the economy and a coastline stretching over more than 800 kilometers along the Gulf of Guinea. These dynamics will bring new challenges for the country's economy and its people, one of them being the increasing displacements and migration as a consequence of climate change.

This study sets out how climate change could increasingly compel vulnerable Nigerians to move because of the intensifying impacts of slow onset climate factors—particularly water stress, declines in crop productivity, and sea level rise compounded by storm surge. It finds that by 2050, up to 9.3 million people could migrate within the country due to such hazards under a pessimistic scenario where collective global action on reducing greenhouse gas emissions falls short of the Paris Agreement and where countries fail to take far-sighted action that would enable inclusive, green, resilient development.

Locality matters, so the impacts of climate change will not affect the entire country equally. Some parts will see an emergence of climate migration hotspots. This holds true not only for areas that are poor and have to cope with pre-existing vulnerabilities, like Kano in the north, but also for important economic growth centers like Lagos and other major urban areas along the coast.

Collective global action to rapidly cut emissions is an imperative to avert the worst consequences of climate migration. At the same time, this must be accompanied by a far-sighted strategy to avert, minimize, and better manage distress migration through inclusive development that is green and clean.

There is a real opportunity for Nigeria to harness the potential of its youth to support its growth and to manage climate migration in way that supports social and economic transformation. Acknowledging climate change and particularly its impacts on mobility as a major challenge for the country, the World Bank Group is committed to support Nigeria in this process, helping it to reduce poverty and promote shared prosperity in a sustainable manner.



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# Executive summary

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## MESSAGE 1

Nigeria is a highly mobile country where the potency for climate change to drive internal climate migration will increase in the coming decades.

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**The World Bank's Groundswell reports set out the potency for climate change to drive internal climate migration (Rigaud et al. 2018, Clement et al. 2021), with Sub-Saharan Africa being the most affected.**

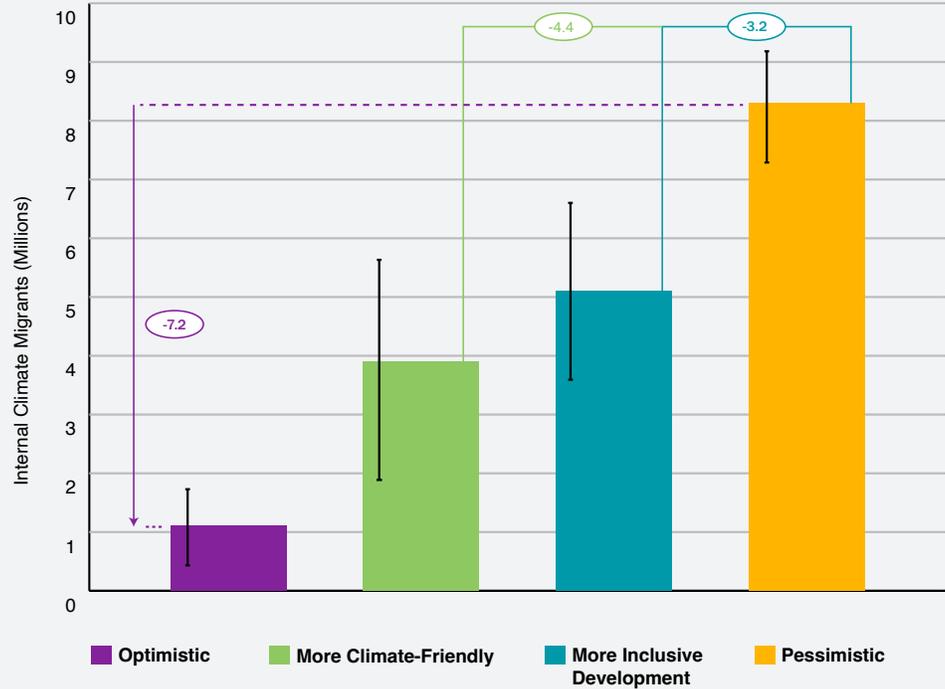
An expanded and deeper analysis through the Groundswell Africa report, focusing on West African countries, reaffirms this pattern region (Rigaud et al. 2021a). The recent study projects that by 2050, without concrete climate and development action, West Africa could see up to 32.0 million people moving within their countries as a consequence of slow-onset climate impacts, such as water stress, drops in crop and ecosystem productivity, and sea level rise compounded by storm surge. These spatial population shifts could represent up to 4.06 percent of the total population of West African countries in 2050. Understanding the scale and the patterns of these climate-induced spatial population shifts is critical to inform policy dialogue, planning, and action so as to avert, minimize, and better manage climate-induced migration for dignified, productive, and sustainable outcomes.

**Nigeria has a long history of mobility, and migration patterns have historically been dynamic.** The migration towards north-central zones as well as southward toward Lagos and other coastal cities is influenced by climate change and environmental conditions as well as better economic opportunities. In recent years, severe floods have led to loss of lives, housing and infrastructure, and compelled Nigerians to move out of areas affected by the disasters.

**Climate change is a reality in Nigeria, and is projected to affect most of the sectors of the economy directly dependent on healthy ecosystems and natural resources.** The country is likely to experience rising temperatures, erratic and increasingly intense rainfall events, flooding, and coastal erosion owing to heightened storms and sea level rise. Mobility is also used as a coping strategy to address both ex-ante and ex-post risks, in particular by the most vulnerable portions of the population. Therefore, having a better grasp of the scale and shape of current and future dimensions of climate-induced migration in Nigeria will support the planning process of future development strategies and transform this emerging complex issue into a more manageable one.

**Internal climate migration in Nigeria could reach a high of 9.4 million by 2050, the second highest among West African countries after Niger.** This figure will represent 2.18 percent of the projected 2050 population, at the high end of the pessimistic scenario, which combines high emissions with unequal development. Under alternative scenarios—the more inclusive and climate-friendly—the scale of climate migration would be reduced. The greatest gains are realized under the optimistic scenario, which combines low emissions with moderate development pathways (figure ES.1). The number of climate migrants would drop from a mean value of 8.3 million under the pessimistic scenario in 2050 to 1.1 million in 2050 under the optimistic scenario, which translates into a reduction of about 87 percent. This underscores the critical need for both inclusive development and low emissions to modulate the scale of climate migration—with the greatest gains achieved through early action. These results are the outcome of the enhanced version of the pioneering Groundswell modelling approach applied to West African countries (Box ES.1).

**Figure ES.1 Projected Total Internal Climate Migrants in Nigeria by 2050**



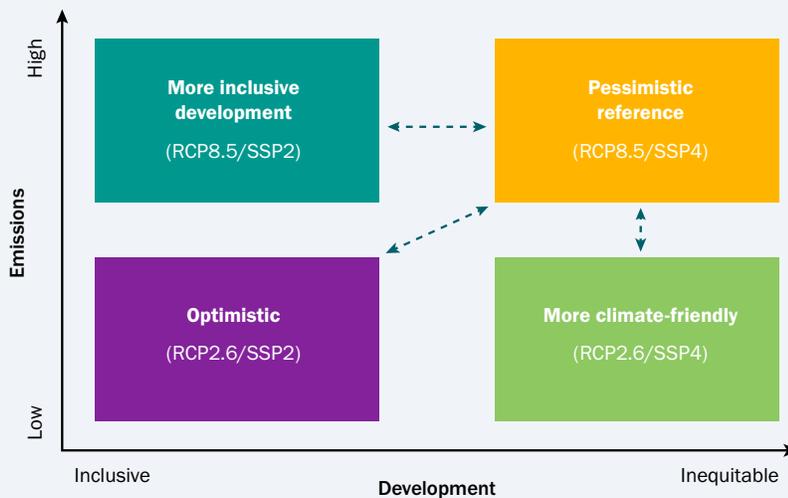
Note: The whiskers represent the lowest and the highest number of internal climate migrants in that scenario.

## Box ES.1 Enhanced Groundswell Model—Applied to the West Africa Groundswell Study

The results described in this study are based on the application of an enhanced version of the pioneering Groundswell model (Rigaud et al. 2018). New features include the optimistic scenario, and additional climate (net primary productivity, flood risk) and nonclimate factors as variables.

A scenario-based approach—reflecting different combinations of future climate change impacts and development pathways—is used to characterize the scale and spread of climate migration by 2050.

### Projecting Internal Climate Migration under Four Plausible Scenarios



Note:

1. The scenarios are based on combinations of two Shared Socioeconomic Pathways—SSP2 (moderate development) and SSP4 (unequal development)—and two Representative Concentration Pathways—RCP2.6 (low emissions) and RCP8.5 (high emissions).
2. Estimates of climate migrants are derived by comparing these plausible climate migration (RCP-SSP) scenarios with development only (SSP) or the “no climate impact” scenarios

The expanded model provides a more granular analysis and is better placed to inform policy dialogue and action. To estimate the scale of internal climate migrants a population gravity model was used to isolate the portion of future changes in population distribution that can be attributed to climate change as a proxy for climate migration. To capture the effects of slow onset climate factors on internal migration, the methodology used state of the art simulations for crop, water, net primary productivity (NPP), flood risk models, and sea level rise with storm surge. Non-climate factors were considered, including demographic variables (sex and median age) and conflict. This expanded model was also used to analyze internal climate migration in the Lake Victoria Basin Countries (Rigaud et al. 2021b).

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## MESSAGE 2

Internal climate migration will ramp up by 2050—early action combining concrete climate and development action is an imperative to avert, reduce and manage its scale.

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**For Nigeria, all the four modelled scenarios display an upward trend in internal climate migration by 2050.** Between 2025 to 2050, the number of internal climate migrants could see up to a 2.5-fold rise (under the pessimistic scenario). At the same time, it is noteworthy that the trajectory depicts an upward acceleration in 2045–2050 in accordance with the escalation of climate impacts in the coming decades. The latest science and projections from the United Nations Intergovernmental Panel on Climate Change (IPCC)'s Sixth Assessment Report (IPCC 2021) on warming and impacts could challenge the prospects of reducing the scale of climate migration.

**Climate-induced migration could emerge as a significant type of internal migration in Nigeria by 2050.** The share of climate migrants could increase steadily as a share of other internal migrants across all scenarios, with the largest increase projected under the pessimistic scenario. By comparing population projections, with and without climate factors, the assessment shows that the number of climate migrants could represent as much as 40 percent of other internal migrants. These projections indicate Nigeria's sensitivity to climate and the potency to drive future mobility.

**A more focused analysis of the 5-kilometers coastal belt indicates that Nigeria could see up to 1 million climate out-migrants from the coast by 2050.** A number of dense settlements located in the coastal areas in Lagos and along the Niger delta river are particularly vulnerable. This movement can be explained by sea level rise impacts, compounded by storm surge, which will result in loss of habitable land. These factors are unlikely to stop growth in the economic hubs in the coastal zone like Lagos, but their population growth may be dampened by climate-induced migration. The awareness of the spatial dimension of the challenge, accompanied by early attention to these emerging hotspots is pivotal to build resilience and deliver on continued economic growth and prosperity.

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## MESSAGE 3

The emergence of internal climate migration hotspots in Nigeria—and their convergence with both centers of economic growth and impoverished areas—requires holistic and far-sighted approaches to ensure sustainable and durable outcomes.

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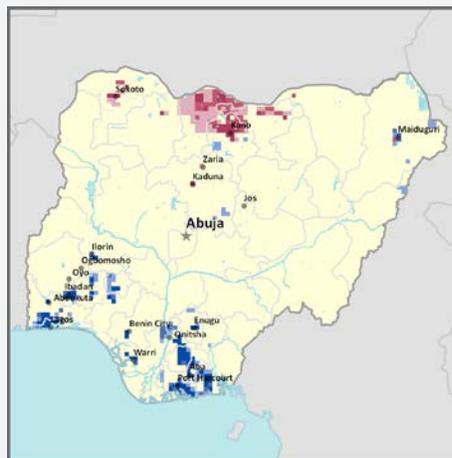
**Climate in- and out-migration hotspots in Nigeria could emerge as early as 2030 and continue to increase in strength and spread geographically (figure ES.2).** These plausible hotspots represent areas where population movements are considered high certainty across the scenarios modelled. These shifts are in response to the changing viability of ecosystems and landscapes to support livelihoods due to changing water stress and drops in crop and ecosystem productivity. Dense-settlement consistently show climate out-migration across scenarios and for each decade, whereas rainfed croplands consistently show climate in-migration across scenarios and for each decade. Lagos, near the Niger delta, is expected to experience a noticeable decline in net climate migration. Meanwhile, the city of Maiduguri in the state of Borno stands out mostly as an out-migration hotspot. Focusing on these hotspots and considering the spatial dimension of the challenge will be critical to build resilience and readiness across timescales.

**Figure ES.2 Projected Hotspots of Climate In- and out-migration in Nigeria by 2030 (left) and 2050 (right)**

a. 2030



b. 2050



**IN-MIGRATION**

- High certainty in high levels of climate in-migration
- Moderate certainty in high levels of climate in-migration
- Low certainty in high levels of climate in-migration

**OUT-MIGRATION**

- High certainty in high levels of climate out-migration
- Moderate certainty in high levels of climate out-migration
- Low certainty in high levels of climate out-migration

Note: High, moderate, and low certainty reflects agreement across all four, three, and two scenarios modelled respectively. In- and out-migration hotspots are thus areas in which at least two scenarios concur on density changes. Data is for the top and bottom 5th percentile differences in the density distribution for climate in- and out-migration, respectively.

**Climate out-migration is projected for the south/southeast and coastal states like Lagos, Ogun, Rivers, Ondo, Delta, Bayelsa, and Akwa.** These localities correspond with areas of lower poverty incidence and could experience population dampening due to internal climate migration. These trends run counter to the historical migration patterns which have been towards coastal areas. Indeed, coastal areas have been a major attraction for people in Nigeria leaving rural areas in search for better economic opportunities. However, the exposure and vulnerability of Nigeria’s coastal activities and infrastructure to climate change risks also increase the probability of secondary migration of internal migrants further inland. On the other hand, climate in-migration is projected for states in the north and north west like Kano, Katsina, and Sokoto where poverty incidence is the highest and population density is already high (Kano, Sokoto). Beyond the hotspots, the population change per square kilometre owing to climate migration in Nigeria is projected to be positive in the north, north-west and south, and negative in south and central parts of the county with some variations across the four scenarios by 2050.

**Water stress, crop and NPP losses, and sea level rise are key factors that will influence the patterns and scale of internal climate migration in Nigeria over the next decades.** Generally, areas that see positive deviations in water and crop productivity experience more in-migration, as represented through spatial population distribution shifts. The coefficient for water availability in rural areas is around 2.7 to 2.8 times higher than that of crop production and NPP, illustrating the importance of water availability as a driver of migration. In spite of noticeable differences between models with regards to water availability, results show a wetter trend in Nigeria in particular in the north/north-east regions compared to the rest of the country and generally modest shifts elsewhere. Projections for crop production reveal a nuanced pattern, whereby one crop simulation model shows between 10 and 30 percent declines in crop production in the middle belt of the country, while another model shows more mixed results including areas with increases

in crop production. Climate impacts will continue to amplify beyond 2050, with models indicating increase in water availability, most pronounced in the North and East while in some models, a decrease of water availability in the East. Several models also show declines in crop production in large tracts of the country, while others show marginal increases. Sea level rise, compounded by storm surge, was included as a spatial mask moving people out of inundated and inhabitable areas. In the context of nonclimate factors, higher median age is associated with migrant-attracting urban areas in West African countries, dampening the effect of water stress, which would otherwise drive climate out-migration.

**The climate migration hotspots in Nigeria are not predestined, but the agreement across the scenarios on climate in- and out-migration underscores the need for farsighted and anticipatory approaches to avert, minimize, and plan for the consequences and opportunities of climate-induced migration.** These approaches may require *adapt in place measures* to protect communities and assets and provide basic services and job opportunities. *Managed retreat* will be needed in areas that pose high levels of climate risks to enable and support mobility. Action has to span the entire migration life cycle: adapt in place, enable mobility, and *postmigration support* mechanisms, and consider spatial and temporal scales.

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## MESSAGE 4

**Global responsibility for swift action to cut greenhouse gas emissions is an imperative and critical for significantly reducing the scale of internal climate migration.**

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**Concerted action at the global level to reduce greenhouse gas (GHG) emissions is an imperative to reduce the climate pressures that drive people to migrate.** Commitments to cut GHG emissions globally are off-track to meet the Paris targets. The latest IPCC report (2021) finds that the global average temperature increase will exceed 1.5°C during the 21st century unless there is a deep reduction in GHG emissions in coming decades (IPCC 2021). Without immediate, rapid, and large-scale reductions in GHG emissions, limiting warming will be beyond reach (IPCC 2021). Beyond the threshold temperatures, climate-related risks for natural and human systems are higher, with disproportionate impacts on the poorest and most vulnerable (IPCC 2021; UNEP 2020). Current emissions from Sub-Saharan Africa are small but countries are stepping up action on this front. Nigeria has committed to raising its climate ambition with unconditional contribution of 20 percent below business-as-usual (BAU) by 2030 and 47 percent conditional contribution based on international support. Most importantly, however, we need collective global action from high emitting countries to cut their GHG emissions, and avert an escalation of climate impacts that will continue to drive climate migration, even as we recognize that some of these impacts are already locked in. Major GHG emission countries must find direct and indirect ways to complement Nigeria's efforts on climate-induced migration.

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## MESSAGE 5

**Inclusive, resilient, and green development can be nurtured into a positive force through a focus on a core set of policy areas informed by domains of action.**

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**Internal climate migration cannot be divorced from development, and as the human face of climate change, it must be addressed in a holistic, end-to-end manner.** The Migration and Climate-informed Solutions (MACS) framework (figure ES.3) brings together domains of action, buttressed by core policy areas, to reduce the scale of climate-induced migration, usher in social and economic transformations, and reduce vulnerabilities. Applying this anticipatory approach will ensure that Nigeria's economy is braced not just for the challenges but also the opportunities of climate migration.

**The core policy areas, as advocated by the Groundswell report, remain critically important:**

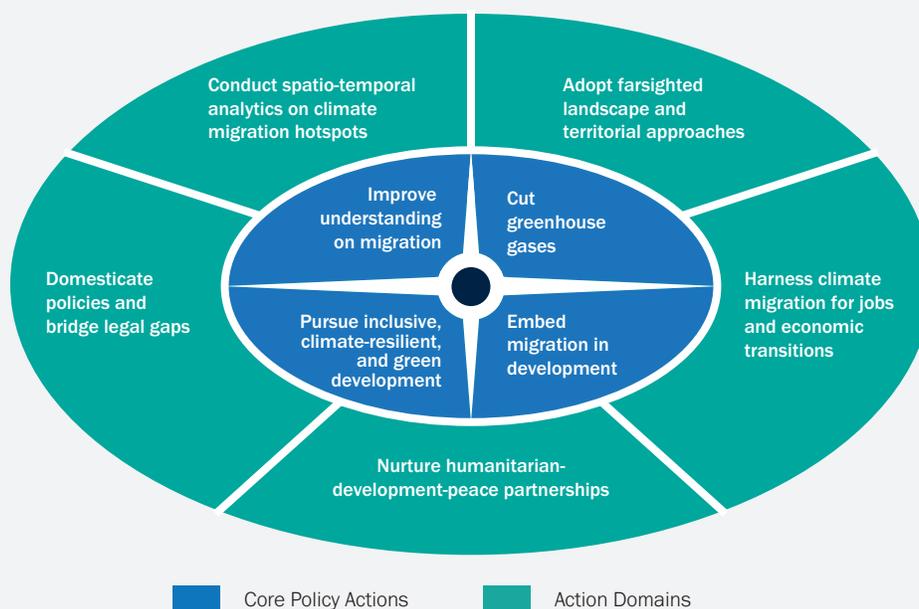
1. Cut GHGs now.
2. Pursue inclusive, climate-resilient, and green development.
3. Embed climate migration in development planning.
4. Invest in an improved understanding of migration.

**The diversity of contexts in Nigeria where internal climate migration will play out calls for focused attention and solidarity, which can be guided by five action domains to avert migration driven by adverse impacts of climate change.** These include:

- Conduct spatio-temporal analytics to understand the emergence of climate migration hotspots.
- Adopt farsighted landscape and territorial approaches.
- Harness climate migration for jobs and economic transitions.
- Nurture humanitarian-development-peace partnerships
- Domesticating policies and bridge legal gaps.

Action must be pursued through dedicated local and national action and regional cooperation, as appropriate.

**Figure ES.3 Migration and Climate-informed Solutions (MACS)<sup>a</sup>**



Source: Rigaud et al. 2021a.

a. MACS was derived as part of the two Groundswell Africa regional reports: *Groundswell Africa: Internal Climate Migration in West African Countries* (Rigaud et al. 2021a) and *Groundswell Africa: A Deeper Dive into Internal Climate Migration in the Lake Victoria Basin Countries* (Rigaud et al. 2021b).

### Box ES.2 The MACS Framework

The MACS framework is the outcome of the World Bank's efforts through the Groundswell reports (Rigaud et al. 2018; Clement et al. 2021) and subsequent deeper dives via Groundswell Africa (Rigaud et al. 2021a and 2021b) to better understand the implications of climate-induced migration and mainstream this phenomenon into development plans, programs, and policies. It stems from the result of the abovementioned modelling exercise, contextualized against current and historical mobility patterns, peer reviewed literature, and multi-stakeholder consultations. A portfolio review of the design features of 165 World Bank projects operating at the climate-migration-development nexus further informs this framework (Rigaud et al. 2021c). MACS is flexible and adaptive, based on the premise that climate migration is linked to broader development challenges across spatial scales. It can guide policymakers and practitioners by offering critical information and insights related to development and policy implications of climate-induced internal migration. This reflects the call for anticipatory approaches over larger time and spatial scales to avert and minimize the adverse consequences of climate-induced migration and harness opportunities brought forth by migration.

**The right set of climate and development policy, underpinned by the MACS framework and in alignment with country's development vision and plans, can help avert adverse outcomes while harnessing the opportunities of climate-induced migration.** Nigeria's 2017–2020 Economic Recovery and Growth Plan (ERGP) aims to boost sustainable economic growth in the country while unlocking the innovative potential of its population. All five strategic priority intervention sectors from Nigeria's ERGP (and its second Priority Action Plan for 2019–2023) provide several entry points to address and mainstream climate-induced migration in development and planning processes. The examples of entry points include refurbishing

hubs for ICT development to create jobs for the youth, supporting special economic and industrial zones, boosting crop productivity in agriculture and outputs of other sub-sectors (forestry, fisheries), promoting irrigable land and river basin management infrastructure efficiently to support year-round agricultural production and food security, delivering high priority transportation, and enabling private sector financing.

**The development community is not starting from zero.** The World Bank (Rigaud et al. 2021c) carried out a portfolio review to draw actionable insights from 165 World Bank projects operating at the climate-migration-development nexus with commitments amounting to US\$197.5 billion (from 2006 to 2019). The portfolio review findings show that a more systematic and anticipatory approach in designing projects geared toward addressing climate migration is possible. Increasingly, projects not only address migrants' direct needs but also provide for enabling interventions (early warning systems and social safety nets) and address root causes of mobility by investing in environmental restoration. There is a need to step up these measures with great vigor and urgency—acting in partnership and engagement of those directly affected.

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## MESSAGE 6

**Nigeria must act boldly and urgently on internal climate migration—delaying action will raise the stakes considerably.**

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**The call for action on internal climate migration is clear and compelling.** The potential scale of the issue, trends, and emergence of climate migration hotspots as early as 2030 should have major implications on conceiving effective responses. The domains of action set out in the MACS framework provide a pragmatic and farsighted approach to addressing internal climate migration—delaying action will raise the stakes considerably. They can bolster the delivery of the core policies to reduce, avert, and minimize distress-driven internal climate migration.



**Investing in iterative scenario modeling, grounded in new data and development progress, will be crucial to support decision-making.** Such investments should try to facilitate long-term planning, such as in adaptive capacity, to secure climate resilience. This will require not only action at the international and national level but also locally.<sup>1</sup> The Nigeria Erosion and Watershed Management Project presents a concrete example of locally-led watershed management to reduce vulnerability to soil erosion.



**Landscape and territorial approaches will enable early planning and action across spatial and time scales in climate in- and out-migration hotspots.** Climate change can degrade land, water and natural resource base thereby creating conditions for migration and displacement. An approach to addressing the underlying causes of the adverse consequences of climate migration, the role of land and water degradation, and the ability to support livelihood in the face of both slow- and rapid-onset climate factors and their interlinkages is important in Nigeria. Understanding and mapping climate impacts, community livelihoods (and adverse consequences) and emerging hotspots will be key. Nigeria's coast is home to approximately 50 million people and serves as a vital source of livelihoods through artisanal fishing, agriculture and tourism, gas and oil exploitation, shipping, and military activities. The capital Lagos is an economic hub, but it is also among the top 10 vulnerable cities in the world. Local Integrated Coastal Zone Management (ICZM) plans and analysis of adaptation options will allow communities to address the balance between the coastline and riverine estuaries and thereby potentially avoid the loss of land and livelihoods due to severe marine erosion.

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1. The findings of this report can serve as a useful guidance tool to hold on-the-ground dialogue with stakeholder groups and develop concrete policy response that caters to the particularities of local context.



**Climate-induced migration provides opportunities to foster climate smart jobs and support economic structural transformation in Nigeria.**

Lagos offers a positive example of state reforms wherein public expenditure has been instrumental to social programs such as education to help manage the large inflow of in-migration from rural areas. Supporting policies, which aim to absorb a large youth bulge into non-agricultural and less climate-sensitive sectors, will be key. Climate-smart urban transitions should build the skills of the young segments of the population. Enhanced collaboration with the humanitarian, security, and disaster communities across the mobility continuum, building on each sector's comparative advantage, remains essential, in particular in the northern parts of the country. The MACS framework address the same core sustainability challenges depicted in the Green, Resilient and Inclusive Development (GRID) framework developed recently by the World Bank to support its clients reach strong and durable growth.



**Cooperation among the development, humanitarian, and peace communities working across the mobility continuum could support Nigeria achieve holistic and durable solutions to climate-induced migration and displacement.**

This approach can benefit from the comparative advantage of different actors to strengthen local capacity. Ultimately, holistic approaches are geared to reduce risk and vulnerability through well-aligned short-, medium- and longer-term contributions by humanitarian and development actors. World Bank financing instruments and other technical support modalities provide support to climate migrants, and there is potential for further support focusing on development opportunities and policies for the safe movement of people and provide viable options for *in situ* adaptation.



**A well-defined, equitable, and implemented legal architecture brings clarity, protects affected individuals and communities, and reconciles international funding and local decision-making.**

It ensures that migration acts as a force of good for all strata of the society. Ensuring that existing legal frameworks are in line with the Kampala Convention and international frameworks such as the Guiding Principles on Internal Displacement will bolster the legal architecture to address climate-induced migration.

**While a potent and daunting challenge, climate-induced migration presents an opportunity for Nigeria to advance socioeconomic goals.**

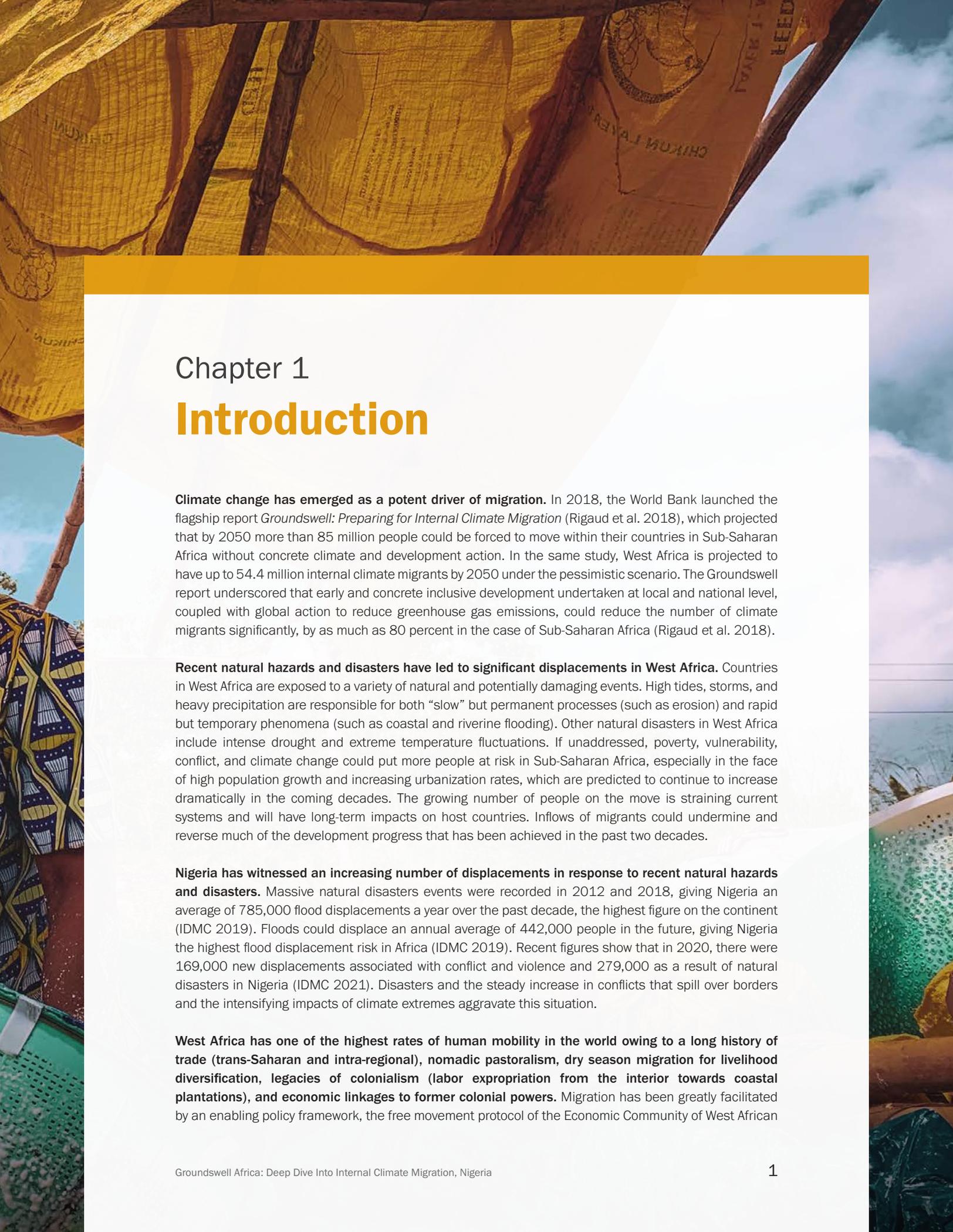
It presents a policy challenge that cannot be wished away but should be tackled holistically and effectively through evidence-based, participatory action. Climate-friendly, inclusive development can significantly reduce the scale of migration and serve as the first line of defense. The country can embark on a green, resilient, and inclusive path for development by exploiting new economic opportunities and recognizing that these structural transformations will need to take place in a context of climate change and internal climate migration. Foresighted and transformative action, across the migration cycle, will go a long way to ease people out of vulnerability and help secure the foundations of a peaceful, stable, and secure Nigeria.

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Tope A. Asokere / Pexels



## Chapter 1

# Introduction

**Climate change has emerged as a potent driver of migration.** In 2018, the World Bank launched the flagship report *Groundswell: Preparing for Internal Climate Migration* (Rigaud et al. 2018), which projected that by 2050 more than 85 million people could be forced to move within their countries in Sub-Saharan Africa without concrete climate and development action. In the same study, West Africa is projected to have up to 54.4 million internal climate migrants by 2050 under the pessimistic scenario. The Groundswell report underscored that early and concrete inclusive development undertaken at local and national level, coupled with global action to reduce greenhouse gas emissions, could reduce the number of climate migrants significantly, by as much as 80 percent in the case of Sub-Saharan Africa (Rigaud et al. 2018).

**Recent natural hazards and disasters have led to significant displacements in West Africa.** Countries in West Africa are exposed to a variety of natural and potentially damaging events. High tides, storms, and heavy precipitation are responsible for both “slow” but permanent processes (such as erosion) and rapid but temporary phenomena (such as coastal and riverine flooding). Other natural disasters in West Africa include intense drought and extreme temperature fluctuations. If unaddressed, poverty, vulnerability, conflict, and climate change could put more people at risk in Sub-Saharan Africa, especially in the face of high population growth and increasing urbanization rates, which are predicted to continue to increase dramatically in the coming decades. The growing number of people on the move is straining current systems and will have long-term impacts on host countries. Inflows of migrants could undermine and reverse much of the development progress that has been achieved in the past two decades.

**Nigeria has witnessed an increasing number of displacements in response to recent natural hazards and disasters.** Massive natural disasters events were recorded in 2012 and 2018, giving Nigeria an average of 785,000 flood displacements a year over the past decade, the highest figure on the continent (IDMC 2019). Floods could displace an annual average of 442,000 people in the future, giving Nigeria the highest flood displacement risk in Africa (IDMC 2019). Recent figures show that in 2020, there were 169,000 new displacements associated with conflict and violence and 279,000 as a result of natural disasters in Nigeria (IDMC 2021). Disasters and the steady increase in conflicts that spill over borders and the intensifying impacts of climate extremes aggravate this situation.

**West Africa has one of the highest rates of human mobility in the world owing to a long history of trade (trans-Saharan and intra-regional), nomadic pastoralism, dry season migration for livelihood diversification, legacies of colonialism (labor expropriation from the interior towards coastal plantations), and economic linkages to former colonial powers.** Migration has been greatly facilitated by an enabling policy framework, the free movement protocol of the Economic Community of West African

States (ECOWAS), which enshrines the ability of West African citizens to live and work in any country of the region. The region also has experienced and is likely to experience in the future some of the worst impacts of climate change, including rising temperatures, erratic rainfall, increasingly intense rainfall events, flooding, and coastal erosion owing to heightened storms and sea level rise. When coupled with the high dependence of most coastal countries on the agriculture and fisheries sectors, a growing coastal tourism sector, as well as the high concentration of people and assets along the coast, the economy and livelihoods of West African countries are highly vulnerable to climate variability and change.

**Climate migration is emerging as an issue of critical importance in the face of escalating climate impacts** (Rigaud et al. 2018). Productive systems may reach limits to adaptation as climate impacts become more severe over the course of this century, which may result in shifts in population distribution as mostly rural agriculturalists move from highly impacted areas towards regions with better conditions for the crops and livestock on which they depend. More importantly, in areas where development deficits and a lack of adapt-in-place opportunities persist, the chances for internal migration may be accelerated as people move to secure livelihood options in areas that are more viable. Concerted action on climate change mitigation and adaptation, together with inclusive development policies and embedding climate migration into policy and planning, could help to substantially reduce the number of climate migrants (Rigaud et al. 2018).

**Governments and development partners can no longer assume that the evolution of population distributions will remain unchanged.** There is an urgent need to go beyond individual case studies and specific events to assess how the escalation of climate impacts could drive migration at scale in the coming decades, with a view to drive informed policy and planning.

**Understanding when, where, and how climate migration will unfold is critical for countries and communities to pursue the right policies and targeted action.** It is recognized that the drivers of displacement in the region are a complex overlap of social, political, economic, and environmental factors, particularly slow-onset hazards such as drought, desertification, coastal erosion and land degradation.

## 1.1 SCOPE, OBJECTIVE, AND METHODOLOGY

### *Scope and Objective*

**West Africa is a hotspot of current and future climate impacts** (Muller et al 2014; Niang et al 2014; Turco et al 2015). Major impacts identified in the literature include rising temperatures, heat waves, erratic and increasingly intense rainfall (delays in monsoon onset or dry periods during the rainy season), flooding, and coastal erosion owing to heightened storms and sea level rise. In terms of local livelihoods, these trends are exacerbated by a degraded natural resource base caused by rising population and limited agricultural productivity.

**As climate change affects precipitation and temperature levels in West Africa, this has consequences on livelihoods, particularly where these are climate sensitive, including agriculture, pastoral, and livestock-related sectors.** West Africa faces the distinct possibility of increasing rates of mobility both within countries and across international frontiers. While recent economic growth in the region has fuelled migration to urban areas, it also has made rural areas more viable than in the past due in part to the agriculture-led nature of this growth. Understanding the scale of internal climate migration and the patterns of people's movements is critical to countries so they can plan and prepare.

**The objective of this report is to convey the potency of climate-induced migration within Nigeria to inform policy makers about the urgency for near and farsighted planning, policy, and action as an integral part of the development responses.** This work builds on the modelling described in the *original Groundswell report* (Rigaud et al. 2018) that employs combinations of development scenarios (shared socioeconomic pathways or SSPs) and climate impact scenarios under both high and low emission scenarios (representative concentration pathways or RCPs) to project internal climate migration up to 2050. This report expands on this methodology and qualitative contextualization to set out core policy

directions and domains for action to better anticipate and prepare for the issue. The importance of overarching policies that embed climate risks and opportunities, as well as climate migration, into national and local development planning are paramount. Policy decisions made today will shape the extent to which the effects of climate change will be positive for migrants and their families, sending and receiving communities, and for equitable national economic growth. Inaction would mean missing a vital opportunity to reconfigure where, when, and how climate-resilient investments are made in support of robust economies.

### Methodology

**This study adopts and expands on the scenario-based approach of the Groundswell report (Rigaud et al. 2018) with some enhancements to better inform policy dialogue and action.** The modelling results presented in this report are part of the Groundswell Africa report focusing in West African countries (Rigaud et al. 2021a).<sup>2</sup>

The key elements of the *Groundswell* methodology (Box ES.1) are the following:

- The Groundswell uses a **population gravity model** to isolate the portion of future changes in population distribution, accordingly to the perceived attractiveness of different locales, to slow-onset climate factors over time.
- It develops **plausible scenarios** to characterize the **scale and spread of internal climate migration** using representation concentration pathways (RCPs) and shared socioeconomic pathways (SSPs). Under **RCP2.6**, greenhouse gas (GHG) emissions begin to decline by 2020 and radiative forcing peaks by midcentury, before declining to near current levels by 2100. RCP8.5 is characterized by increasing greenhouse gas emissions, leading to high atmospheric concentrations.
- The **SSPs span possible future development pathways** for the world and describe trends in demographics, human development, economy, lifestyles, policies, institutions, technology, the environment, and natural resources. The SSP2 (moderate development pathway) and SSP4 (unequal development pathway) used in the model reflect the degree to which the scenarios represent challenges to mitigation (GHG emissions reductions) and societal adaptation to climate change. SSP2 represent moderate challenges for both, and SSP4 represents high challenges for adaptation, low for mitigation (O'Neill et al. 2014).
- The model used the Inter-Sectoral Impact Model Intercomparison Project (ISIMIP) global crop and water simulations (state-of-the-art computer simulations of biophysical climate impacts, which are directly relevant to livelihoods outcomes) and sea-level compounded by storm surge data to capture the slow-onset climate factors.<sup>3</sup>
- Results are **contextualized** against current and historic mobility patterns in peer-reviewed literature, and a multistakeholder consultations to further inform patterns of migration and the proposed response framework.

**The expanded methodology used for this study includes the following enhancements:**

#### (i) Four scenarios

**The Groundswell methodology used three scenarios based on combinations of socioeconomic development scenarios (SSPs) and emissions scenarios (RCPs):** the pessimistic (reference), more inclusive development, and climate-friendly. The enhanced model added a fourth, optimistic scenario, which combines low emissions (RCP2.6) and an inclusive development pathway (SSP2).

2. The study modelled the following West African countries: Benin, Burkina Faso, Cabo Verde, Côte d'Ivoire, Ghana, The Gambia, Guinea, Guinea-Bissau, Liberia, Mali, Mauritania, Niger, Nigeria, São Tomé and Príncipe, Senegal, Sierra Leone, and Togo.

3. For details on the methodology, see Appendix 1 of Groundswell Africa: Internal Climate Migration in West African Countries (Rigaud et al. 2021a).

**The selected development scenarios include a “moderate development” and an “unequal development” scenario.** Under the moderate development scenario, low- and middle-income countries are characterized by moderate population growth, urbanization, income growth, and education. Under the unequal development scenario, low- and middle-income countries follow different pathways. Low-income countries have high population growth rates and urbanization, and low GDP and education levels. Middle-income countries have low population growth rates, high urbanization, moderate GDP, and low education levels. Inequality remains high both across and within countries, and economies are relatively isolated, leaving large, poor populations in developing regions highly vulnerable to climate change with limited adaptive capacity.

**The climate migration forecasts are based on two emissions scenarios.** The lower emissions scenario is a world in which temperatures peak at 0.25–1.5 °C above recent baseline levels by 2050 and then stabilize through the end of the century (IPCC 2014). This is the world of the Paris Agreement, in which countries work together to reduce greenhouse gas emissions to zero within the next 15–20 years (Sanderson et al. 2016). In the higher emissions scenario, temperatures rise by 0.5–2 °C by 2050 and by 3–5.5 °C by 2100.

(ii) *Slow- and rapid-onset*

For the first time, the Groundswell model used actual climate impact models for agriculture and water resources to understand how these would affect future population distributions, as well as sea level rise compounded by storm surge (Rigaud et al. 2018). The enhanced model also included another slow-onset impact (ecosystem impacts) and rapid-onset events (such as flood risk projections).

(iii) *Coefficients*

The enhanced model includes model coefficients that show the influence of the variable on the observed deviation between observed population change and projected population change (spatial shifts) based on historical calibration of climate signal from 1990–2000; and 2000–2010. The variables are crop production, water availability, net primary productivity (NPP), median age, sex ratio, conflict-related fatalities, and flood risk. Crop productivity and net primary productivity are not included in the calibration for urban populations because these would not be hypothesized to have an impact in those areas, since their populations are not directly dependent on cropping or animal husbandry.

The coefficients for the West Africa countries in Table 1.1 represent the average of the coefficients across the two decades for Mauritania, Guinea, and Sierra Leone—the only three countries which had population data that met the criteria needed to undertake the calibration. Note that sea level rise is not considered a driver of migration, but rather is inserted as a spatial mask in the modeling work, to move populations out of inundated areas.

**Table 1.1 Coefficient values for West African countries, representing an average of the calibrations using historical data for Mauritania, Guinea, and Sierra Leone**

Indicator (Driver)	(Parameter) Coefficient		Units
	Urban cells	Rural cells	
Crop production	n/a	0.400	5-year deviation from historic baseline
Water availability	1.696	1.071	5-year deviation from historic baseline
Net primary productivity*	n/a	0.380	5-year deviation from historic baseline
Median age	0.617	0.078	Median age of the population in years
Sex ratio	0.024	0.006	(males/females) ratio
Conflict-related fatalities	-0.025	-0.003	Number of recorded fatalities
Flood risk	0.147	0.020	5-year likelihood of flood event

\* Net primary productivity, which is intended to reflect impacts on pastoral populations, is only included in the model where crop production is not present; n/r = not relevant

Among the climate impacts, *water availability* is the strongest factor, particularly in urban areas, positively correlated with population change—meaning increasing water availability results in increasing attractiveness and vice versa. The coefficient for water availability in rural areas is around 2.7–2.8 times higher than that of either crops or NPP. Other things being equal, areas with better water availability (as measured by the deviation from historic baseline) are projected to have relatively large positive population changes. In rural areas, larger values in crop yields or NPP are also positively correlated with larger population change.<sup>4</sup> The magnitude of the coefficient is smaller, so its effect is not as strong as water availability.

4. Crop production is not used to calibrate urban grid cells.

**Demographic variables of median age and sex (gender) distribution, introduced in the enhanced model applied in this study, impact the climate migration projections through their own relationship with population change** (as derived through the spatial autoregressive calibration, and through their interaction with the climate drivers). In the West Africa region, these demographic variables had the effect of mitigating or dampening climate migration.<sup>5</sup> In contrast, in the Lake Victoria Basin countries the alignment between these factors means that they have the effect of amplifying the impact of climate.

**Spatial data on conflict occurrence was obtained from the Armed Conflict Location & Event Data Project (ACLED) database.**<sup>6</sup> A spatial layer was developed of the point locations of every conflict event for the 10 years spanning 2009 to 2018, and the values at each point were the number of fatalities, determined using spatial kriging (a form of interpolation). As expected, conflict-related fatalities are negatively correlated with population change and decreasing attractiveness, again with a stronger effect in urban areas. While the coefficients are small, the range in values is the largest among all layers (from 1 to 259), which means its relative impact in conflict areas is large.

**Finally, flood risk is positively associated with population change, and once again, the effect is larger in urban areas.** Clearly floods do not attract populations; rather it is likely that this reflects the location of many urban areas in coastal areas and flood plains, which are historically prone to flooding.

*(iv) Sea level rise and storm surge*

**The analysis for sea level rise (SLR) is based on projections to 2050 based for the RCP2.6 and RCP8.5 scenario, augmented with an increment to account for storm surge** (table 1.3). The modeling results reflect loss of habitable land for each coastal grid cell linearly interpolated for five-year time steps. Storm surges amplify loss of habitability in the near-term through erosion of coastal landforms that results from wave action. According to Dasgupta et al. (2007), “even a small increase in sea level can significantly magnify the impact of storm surges, which occur regularly and with devastating consequences in some coastal areas.”

**Table 1.3 Projected rise in sea level under low and high Representative Concentration Pathways (meters above current mean sea level)<sup>7</sup>**

Year	RCP2.6			RCP8.5		
	Lower	Middle	Upper	Lower	Mid	Upper
2030	0.092	0.127	0.161	0.098	0.132	0.166
2050	0.157	0.218	0.281	0.188	0.254	0.322
Storm surge increment	0.89-0.9			1.68-1.85		

Source: CIESIN 2013; Church et al. 2013

**Two scenarios meant to be representative of changes in sea level by 2050 associated with RCP2.6 and RCP8.5 were adapted by adding an increment to account for storm surge on top of the estimates.** The figures in Table 1.3 represent the lower-, middle-, and upper-bound sea level rise by 2030 and 2050, as reported by the IPCC (Church et al. 2013). A comprehensive assessment of the likely levels of storm surge for all the coastal areas covered by this report was beyond the scope of this project. Nor were we able to find data on coastal erosion that covers in a consistent manner enough of the coastline. Under RCP2.6, the increment for storm surge was 0.85–0.9 meters, for a total of 1 meter; under RCP8.5, the increment was 1.68–1.85 meters, for a total of 2 meters. These assumptions are applied to all coastlines; they

5. For details on the methodology, see Appendix 1 of *Groundswell Africa: Internal Climate Migration in West African Countries* (Rigaud et al. 2021a).  
 6. See <http://www.acled.org>. Raleigh, C., A. Linke, H. Hegre and J. Karlsen (2010). Introducing ACLED-Armed Conflict Location and Event Data. *Journal of Peace Research*, 47(5) 651-660. <https://doi.org/10.1177/0022343310378914>  
 7. Both the 1- and 2-meter sea level rises are based on NASA Shuttle Radar Topography Mission data, as modified by the Center for International Earth Science Information Network for the Low Elevation Coastal Zone (LECZ) version 2 data set (CIESIN 2013). The increment for storm surge was 0.85–0.9 meters, for a total of 1 meter; under RCP8.5, the increment was 1.68–1.85 meters, for a total of 2 meters.

represent the loss of habitable land as a result of sea level rise plus storm surge in each coastal grid cell. Both the 1- and 2-meter sea level rises are based on NASA Shuttle Radar Topography Mission data, as modified by the Center for International Earth Science Information Network for the Low Elevation Coastal Zone (LECZ) version 2 data set (CIESIN 2013). Processing coastal elevation over large areas is time consuming, and the fact that the global LECZ data were already available expedited this work. That said, there is strong scientific grounding for the addition of the increments (Dasgupta et al. 2007; Hallegatte et al. 2011).

**In the model, the proportion of each grid cell at or below sea level is calculated for 2010 and under the projection to 2050 (for both the 1m and 2m SLR), and the amount is linearly interpolated for each five-year time step in between.** The model implements SLR by progressively removing land from occupation, thereby reducing the population that will be accommodated in a coastal grid cell over time.

*(v) Time and resolution*

**Scenarios were run in decadal increments from 2010 to 2050, calibrated on data from 1990 to 2010.** The future population projections incorporating climate impact scenarios were compared to future population projections without climate impacts to derive estimates of climate migration for 14-kilometer grid cells. Scenarios in the enhanced model run in 5-year increments from 2010 to 2050 and are performed on population data at 1-kilometer resolution; climate migration analysis is carried out at 1 kilometer in the near coastal zone and 14 kilometers elsewhere.

## **1.2 OUTLINE OF THE REPORT**

**This country report is divided into five chapters:** This first Chapter underscores the potency of climate-induced migration and displacement in Sub-Saharan Africa and lays out the scope, objectives, and methodology as applied to Nigeria. Chapter 2 sets out the development, demographic, migration, and climate context for Nigeria, including an overview of historic migration patterns and a brief snapshot of environment-related migration and displacement. Chapter 3 presents the modelling results and plausible future climate migration scenarios from 2020–50, as spatial shifts in future population projections in response to climate impacts. Chapter 4 presents and discusses core policy directions and a set of key domains of action that can be leveraged to foster concrete climate and development action that encompasses near and far-sighted approaches to avert, minimize, and manage internal climate migration and displacement for sustainable growth and resilient and inclusive outcomes. The report concludes with chapter 5, a call to action for Nigeria.



Nupo Dayon Daniel / Unsplash

## Chapter 2

# Country Context

### 2.1 POPULATION AND DEVELOPMENT CONTEXT

**Nigeria is Africa's largest and most populous economy, and is classified as a lower middle-income country.** Nigeria's Gross National Income per capita reached \$2,038 in 2019.<sup>8</sup> Nigeria consists of 36 autonomous states and the Federal Capital Territory and is home to a multiethnic and culturally diverse population. Nigeria's population reached 191 million in 2017 and 195 million in 2018 (Table 2.1). In 2019, the population had risen to 201 million, according to United Nations population figures. Nigeria already hosts 20 percent of the population in Sub-Saharan Africa and almost half of the West African population. Based on projections, Nigeria will become the third most populous country in the world by 2050 with more than 400 million people, thus doubling in size in 30 years. However, population growth is expected to slow down reaching 1.91 percent by 2050 and 0.7 percent by 2100 (compared to 2.59 percent for 2015–2020).

**Nigeria has one of the largest youth populations in the world.** The median age in 2015 was 17.1 years, below Africa's median age of 19.3. The age structure is skewed towards adolescents, in particular adolescent girls. In 2019, the percentage of the population under age 15 reached a staggering 43.7 percent. From 41 million, the number is expected to reach 84 million in 2050, thus more than doubling (World Bank 2006).

**The Nigerian population mostly lives in urban areas, but distribution is not uniform across the country.** In addition to the Federal Capital Territory, the south-east, south-south, north-west (especially Kano) and south-west (especially Lagos) regions show the highest densities. The lowest densities are observed in the north-central (or Middle Belt) and the northeast regions (figure 2.2). Nigeria's urban population was close to 50 percent of the total population in 2017 and is projected to reach 70 percent urban by 2050. The coastline of 853 km hosts approximately 50 million people or 26 percent of the total population.

**Although Nigeria is Africa's biggest oil exporter and has the largest natural gas reserves on the continent,** it is vulnerable to the pronounced decline in oil prices and spikes in risk aversion in global capital markets. Oil accounts for over 90 percent of exports, a third of banking sector credit, and half of government revenues (World Bank 2020b).

**Agriculture employs 36 percent of the labor force<sup>9</sup> and represents 21.2 percent of gross domestic product (GDP) (2018) (Nigeria Federal Ministry of Agriculture and Rural Development 2016).** Nigeria is the world largest producer of cassava and Africa's largest producer of rice (World Bank 2020b). Other significant crops include sorghum and rice paddy. However, about 580,841 km<sup>2</sup> (or 63.83 percent of total land area) is impinged on by desertification caused by climatic variability and anthropogenic activities such as deforestation, extensive cultivation, overgrazing, cultivation of marginal land, bush burning, fuel wood extraction, charcoal production, faulty irrigation systems and urbanization (World Bank 2020b).

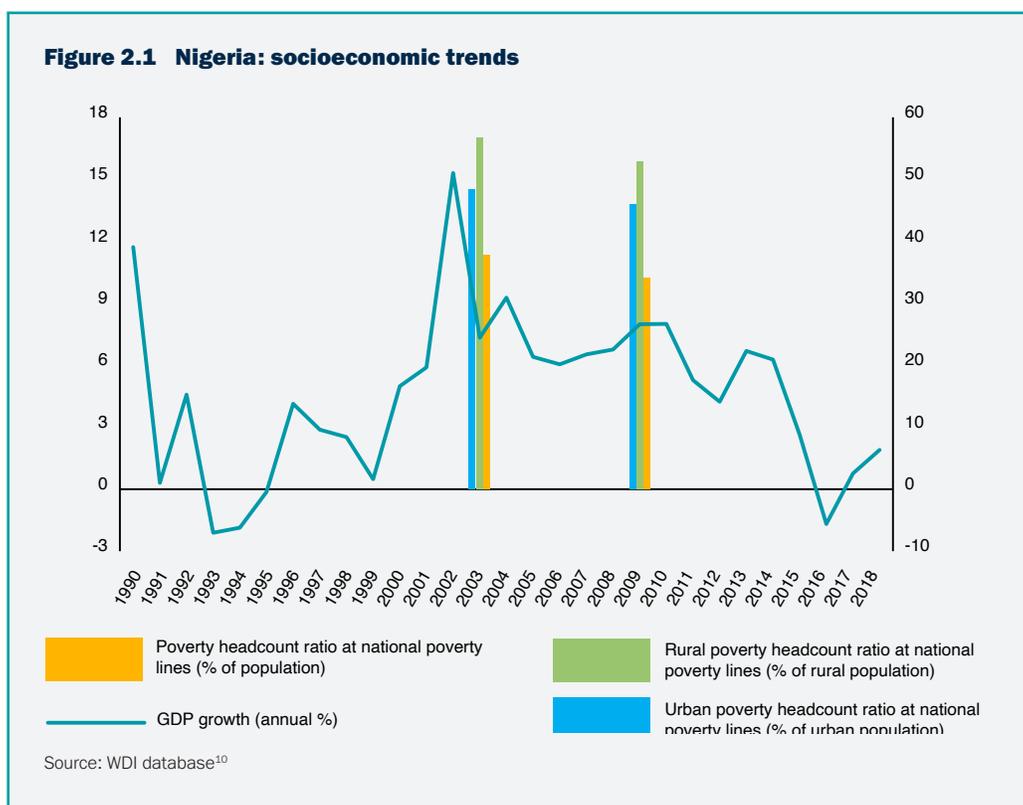
8. See the World Bank Development Indicators (WDI) database, <https://datacatalog.worldbank.org/dataset/world-development-indicators>

9. Over 70 percent of Nigeria's population is engaged in some aspect of agricultural production.

Until 2016, when it experienced its first recession in 25 years, Nigeria's economy was growing fast at 6.3 percent (figure 2.1). The collapse of global oil prices during 2014–16, combined with lower domestic oil production, led to a sudden slowdown in economic activity (-1.6 percent in 2016) (World Bank 2020b). Following the recession (and before COVID struck in 2020) the economy rebounded and grew at 2.2 percent in 2019. The general government fiscal deficit was 4.6 percent of GDP in 2019 (World Bank 2020b), compared to 1.8 percent in 2014, and inflation was in single digits in 2014, compared to about 12 percent in 2019 (World Bank 2020c). GDP is expected to grow modestly by 1.1 percent in 2021, and then recover gradually towards the estimated population growth rate of 2.6 percent (World Bank 2020b).

Nationally, close to 43 percent of Nigerians (83 million people) live below the poverty line, while another 25 percent (53 million) are vulnerable (World Bank 2020c). In spite of some progress in socioeconomic terms in recent years, Nigeria's human capital development remains particularly low due to underinvestment. It ranked 152 out of 157 countries in the World Bank's 2018 Human Capital Index (HCI), with considerable differences between urban and rural areas (World Bank 2020c). The global HCI shows how shortfalls in health and education among children today will reduce the productivity of the next generation of workers.

The Boko Haram insurgency, which began in 2009 in Nigeria's northern state of Borno, combined with counter-insurgency operations and ethnic/communal clashes over scarce resources, have also led to significant casualties and displacement in the Lake Chad region. Conflicts between herding populations and settled farmers are recurrent and hotspots of clashes between herders and farmers include Zamfara, Kaduna, Plateau/Jos, Wase, Kogi/Bassa, Acha, Kwara State, Benue/Agatu, Taraba/Mambilla plateau, Bauchi/Tafawa Balewa, Adamawa/Demsa, and Numan (Krätli and Toulmin 2020b). These conflicts are equally marked and exacerbated by ethno-political tensions. In four Nigerian states, herders are not allowed to move their cattle from one grazing site to another and Fulani herders are labeled as terrorists or alien (Krätli and Toulmin 2020a).



10. World Bank Development Indicators (WDI) database, <https://datacatalog.worldbank.org/dataset/world-development-indicators>

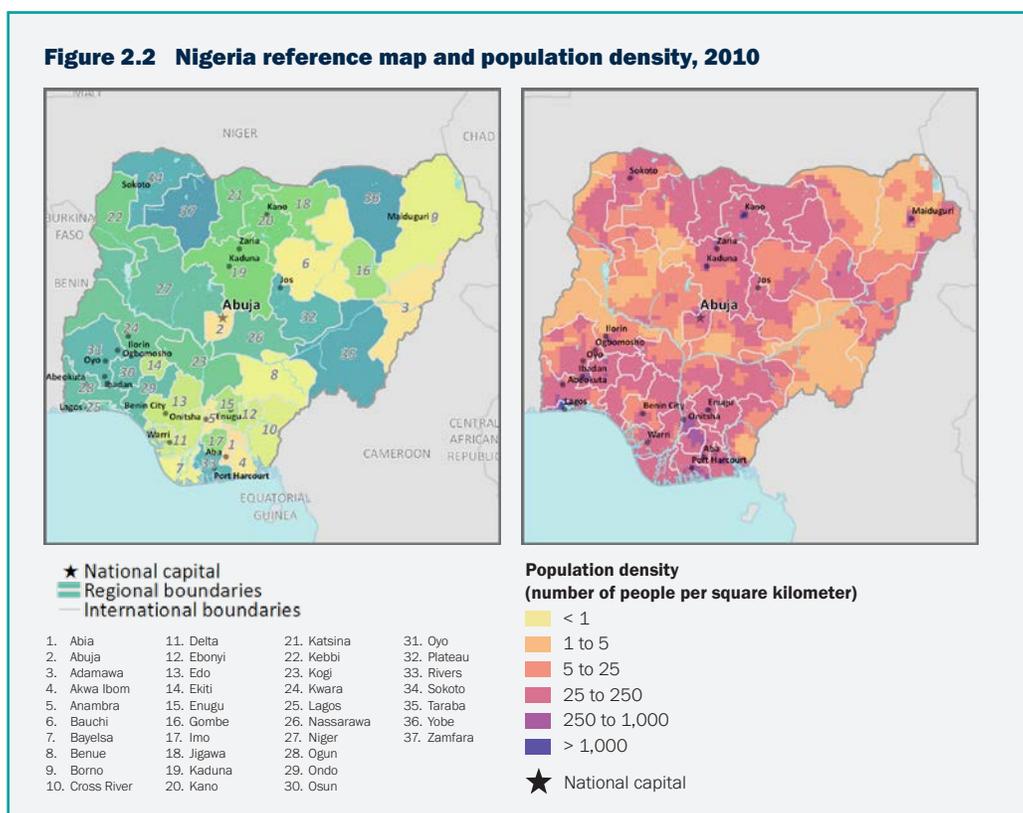
**Table 2.1 Development indicators for Nigeria**

Population	
Population (millions)	195.9
Annual population growth (%)	2.6
Population in 2050 under SSP2 (million)	371.7
Population in 2050 under SSP4 (million)	431.1
Urban share of population (%)	50.3
Employment in agriculture (% of total employment) (2019)	36.4
GDP	
GDP (current \$ billion)	397.3
Annual GDP growth (%)	1.9
GDP per capita (current US\$)	2028.2
Value-added of agriculture (% GDP)	21.2
Poverty	
Poverty headcount ratio at \$1.90 a day (2011 PPP) (% of population) (2009)	53.5
Climate and disaster risk indices	
ND GAIN Index (2017)	
Rank (lowest rank: 181)	148
Score (best score: 76)	37.6

Note: except when noted, data is for 2018.

Note: The ND-GAIN Country Index, a project of the University of Notre Dame Global Adaptation Initiative (ND-GAIN), summarizes a country's vulnerability to climate change and other global challenges in combination with its readiness to improve resilience. A higher score is better. For more information on ND-GAIN, see: <https://gain.nd.edu/>

Source: WDI database<sup>11</sup>



11. See the World Bank Development Indicators (WDI) database, <https://datacatalog.worldbank.org/dataset/world-development-indicators>

## 2.2 MIGRATION PATTERNS

**Migration is a very pervasive phenomenon in Nigeria.** Several drivers, either push or pull factors, (economic, sociocultural, demographic, conflict- and climate change-related stressors) have transformed Nigeria into a country of high internal mobility. In recent years, the conflict and violence from the Boko Haram insurgency have also been the cause for both significant internal and cross-border displacement.

### 2.2.1 Internal migration

**A large number of Nigeria's population migrates internally.** The Internal Migration Survey conducted by the National Population Commission (NPC) in 2010 revealed that 23 percent of the sampled population of Nigerians are internal migrants,<sup>12</sup> 2 percent were returned migrants, and 75 percent were non-migrants. More than half of the internal migrants reside in urban areas (IOM 2016). A large part of the migrants originates from the states of Ogun, Kwara, Osun, and Imo. The states with relatively high proportion of migrants are Abia (48.7 percent), Ekiti (48.1 percent), Delta (45.3 percent), Imo (45.1 percent), Anambra (44.4 percent), Bayelsa (43.2 percent), and Lagos (40.1 percent) (IOM 2016).

**Rural-urban migration is the largest type of migration flow found in Nigeria.** Around 60 percent of the internal migrants in the country in 2010 lived in urban areas (IADD 2019). People from the southern states of the country, including Abia, Akwa Ibom, Anambra, Delta, Edo, Ekiti, Enugu, Ondo, and Oyo, with the exception of Kogi and Kwara states, tend to migrate more than those from the northern states, who are more reluctant to migrate in spite of the conflicts and tension in the north-east. Not surprisingly, Lagos, as the commercial hub of the country, has the highest in-migration. However, there are also rural areas which attract migrants, with rural-rural migrants seeking economic opportunities including farmers, seasonal labourers, and pastoralists from resource-poor to resource-rich rural areas (especially from the savannah zones to the fertile coastal areas). Migration within urban areas is also found along with urban-rural migration (comprising of individuals unable to find jobs in urban areas).

**The country has seen migration towards north-central zones as well as southward toward Lagos and other coastal cities, driven by climate change and environmental conditions as well as more attractive wealth and economic opportunities.** The north-central zone receives more migrants than other zones, followed by south-south, due respectively to the emergence of Abuja as a federal capital city and to the economic pull and attraction generated by the natural resource base (oil).

**As of December 31, 2020, there were 2.73 million displaced people in Nigeria due to conflict and violence.** Nigeria ranked among the top 10 countries with the highest number of people displaced due to conflict and violence by the end of 2020 (IDMC 2021).

### 2.2.2 Cross-border and international migration

**Both immigration and emigration have been on an upward trend from 1990 until 2015 (figure 2.3).** Nigeria's large economy and porous borders have continuously attracted migrants. However, because of the difference between entries and departures, the country exhibits a growing negative trend in net migration (approximately -300,000 since 2010). This trend is expected to remain the same with -310,000 in 2050 and in 2100 (Abel and Cohen 2019). The number of international migrants living in Nigeria is 1.25 million. The majority of immigrants in Nigeria are nationals of the Economic Community of West African States (ECOWAS) countries (51.4 percent), while nearly 16 per cent were nationals of other African countries (IOM 2018). A significant portion of migrants originated from Benin and Ghana. In 2014, Nigeria hosted a total of 1,679 refugees mostly coming from the Democratic Republic of the Congo (35.6 percent) and Cameroon (32.6 percent) (IOM 2018).

12. An internal migrant according to the National Population Commission (NPC) is a person who has not changed location (be it from a Local Government Area or State) for at least 6 months in the last 10 years, while a return migrant is one who has moved out of his current LGA for at least 6 months in the last 10 years before returning.

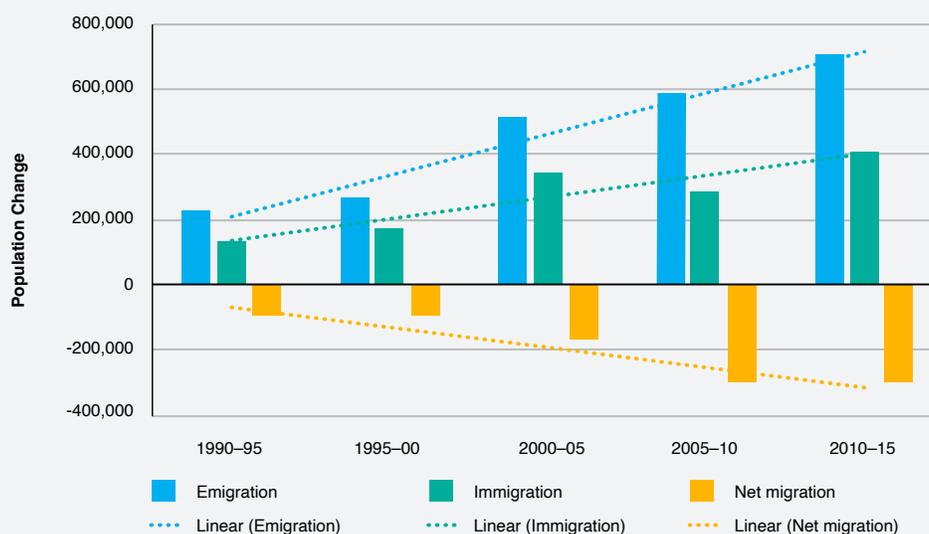
**Nigeria is among the top ten countries receiving remittances (2005–2018).** In 2018, migrant remittances to Nigeria equaled \$23.63 billion, representing 6.1 percent of GDP (WFP 2019). In 2017, Nigeria successfully issued its first diaspora bond, raising USD 300 million to fund infrastructure projects. Ghana and Côte d'Ivoire are the two major destination countries for Nigerian emigrants.

### Box 2.1 Nigeria's Green Bond

**As part of its commitment to the Paris Climate Agreement, Nigeria successfully issued Africa's first sovereign Green Bond (\$30 million) in December 2017.** Recognizing the linkages between climate change and sustainable and equitable growth, Nigeria's objective is to build a climate-resilient society across the country's diverse landscapes. The proceeds of the green bond issue are financing selected carbon-efficient projects mostly in the energy and forestry sectors, creating thousands of new jobs, greening the economy, and reducing carbon emission and deforestation. The selected projects have links to the Economic Recovery and Growth Plan (ERGP) and the Nationally Determined Contributions. The Green Bond Program contributes to Program 47 of the ERGP, striving to build a climate-resilient economy across the country's diverse terrain, crowding in private sector participation, and financing climate change programs in national and sub-national budgets.

Source: World Bank 2020c

**Figure 2.3 Nigeria: International Migration Trends**



Source: Abel and Cohen 2019

### 2.2.3 Environment-driven migration

**Displacements, as a result of rapid-onset events such as floods, are common in Nigeria.** Thousands are usually displaced every year after a flooding. In 2018, a major flood affected 80 percent of the country (12 states) and created 613,000 more displacements (IDMC 2020). Floods occur in lowlands and river basins where people live in densely populated informal settlements. Floods happen not only because of rainfall and overflowing watercourses, but also as a result of water being released from dam reservoirs both in Nigeria and upstream countries (Al Jazeera 2017). Between 2008 and 2012, over 6.8 million people were internally displaced by floods. In 2012, after a massive flood, more than 2 million

people were displaced in 256 local government areas (one third of the total number of LGAs) and 3,870 communities in the country. The flood displacement was more severe in five states, namely Anambra, Kogi, Bayelsa, Rivers, and Niger, and nearly 600,000 homes were destroyed or damaged, especially in Bayelsa and Kogi states.

**In 2018, Nigeria had the highest number of displaced people due to dramatic weather-related events in Africa (more than 500,000).** This number slightly surpassed the number of people displaced due to conflict in the country. Flooding in the states of Adamawa, Akwa Ibom, Benue, Borno, Delta, Lagos, Kano, and Kebbi triggered at least 8,800 new displacements (IDMC 2020). It is noteworthy that some of those forced to flee in certain states had already been displaced by conflict. Populations in the states of Adamawa and Borno, which have long been affected by conflict, have significantly suffered from flooding in 2019 during an exceptionally long rainy season.

**The states in the north-east region of Nigeria have been particularly hit by the consequences of climate change and environmental degradation.** In those states, land degradation, drought, soil erosion, loss of pasture, and increasingly difficult access to water sources and firewood, have led to migration to southern areas of the country. This has exacerbated tensions and caused conflicts in receiving areas over the access, use, and control of natural resources between herders, farmers (sedentary and non-sedentary) and fishermen (who have been forced to adjust to a shrinking Lake Chad). As a result of conflicts between farmers and herders, for example in the Plateau State, thousands of people have been displaced. In northern Nigeria, research has shown that households migrate internally to mitigate against ex-ante and ex-post agricultural risks (weather-related variability and shocks) (Dillon, Mueller, and Salau 2011). In the most conflict-affected states, inability to meet food needs is a stronger push factor compared to other states and regions (WFP 2019).

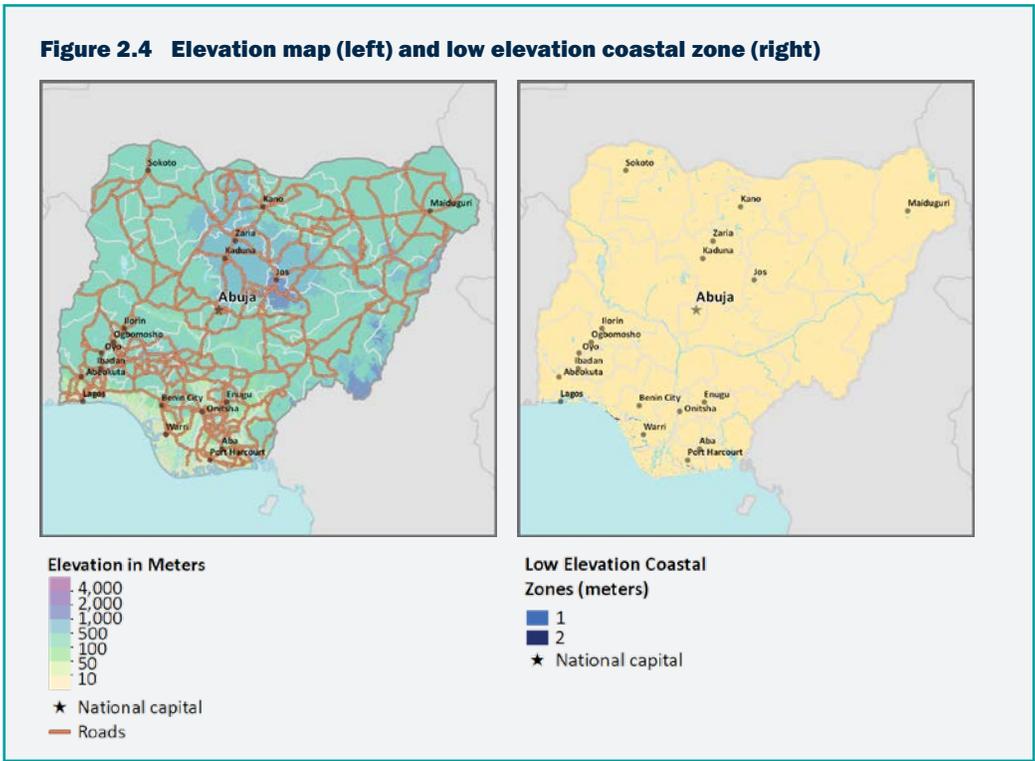
**Gender distinctions in climate-related migration are also apparent in Nigeria.** Studies suggest that households in northern Nigeria send male migrants but not female migrants after temperature shocks (Dillon, Mueller, and Salau 2011). At a country level, the percentage of female migrants is slightly higher (51.5 percent) than the percentage of male migrants (48.5 percent) with Sokoto, Plateau, Adamawa, Jigawa, and Katsina as the five leading states in terms of female internal migrants, according to the Nigeria National Population Commission (NPC) 2012 data. Women typically migrate to improve their educational status, expand employment opportunities, marry and reunite with family, or avoid a marriage they did not sign for.

**Nigerian's coast is home to approximately 25 percent of the population, working in artisanal fishing, agriculture and tourism, gas and oil exploitation, shipping, and military activities.**<sup>13</sup> Climate change impacts mainly through the effects of sea level rise (salinization of aquifers, coastal erosion, coastal flooding) are projected to exacerbate tensions among communities living in the coastal areas (Oppenheimer et al. 2019). Coastal erosion has already led to the evacuation of inhabitants for resettlement. In addition to sea level rise, inland waters such as rivers and mangroves are also at risk of sea water inflow threatening the inland water ecosystems and critical livelihoods which rely on them (agriculture, fishing, industrial activities).

**Climate shocks, such as heavy rainfall and floods, negatively impact the welfare and livelihoods of people dependent on fisheries.** A 2010 study on the welfare of fishermen in the state of Lagos revealed that heavy rainfall adversely affected the fishing communities as most of the respondents lost income due to flooding. Other factors played a role, such as access to credit or size of the households. The study revealed that fishers moved permanently or relocated temporarily to a site with diminished flooding risk as coping strategies (Adeoti, Olayide and Coster 2017).

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13. World Bank WACA Program website: <https://www.wacaprogram.org/country/nigeria>



In Nigeria’s low-elevation coastal zones (LECZs),<sup>14</sup> the population density is 491 inhabitants per km<sup>2</sup>, compared with 215 inhabitants per km<sup>2</sup> countrywide in 2018 (figure 2.4).<sup>15</sup> Based on estimations, a 0.2-meter SLR would bring 3,400km of Nigeria’s coast under water. A 1-meter rise in sea level would inundate 18,400km submerging all critical infrastructure and livelihoods (figure 2.4) and forcing more than 2 million people to migrate from the delta (World Bank 2019b).

### 2.3 CLIMATE CONTEXT AND IMPACTS

#### 2.3.1 Historical, current and future climate

Nigeria has 9 distinct ecological zones, which means significant variation in rainfall patterns, temperature, and environmental vulnerabilities. According to the 2017 Climate Change Vulnerability Index developed by the global risk analytics company Verisk Maplecroft, Nigeria is one of the 10 most vulnerable countries in the world to climate change.<sup>16</sup> According to a 2009 study by the Department for International Development (DFID) on the impact of climate change on Nigeria’s economy, Nigeria could lose 2 to 11 percent of its GDP by 2020 and between 6 and 30 percent of its GDP by 2050, equivalent to a loss ranging between \$100–460 billion (World Bank 2019a).

Precipitation in Nigeria is characterized by high variability across the country and inter-annual fluctuations, while temperature has increased over the decades. While the north receives less than 400 mm of precipitation on average annually, the south records more than 1,800 mm on average. Over the last few decades, Nigeria has witnessed extreme climate events such as droughts and floods. Nigeria is at the confluence of two major West African rivers, the Niger and the Benue, which meet in the center of the country. Further, there has been less rain falling over the country. Mean annual precipitation has decreased by 3.5 mm per month per decade between 1960–2006. Finally, mean annual temperatures have consistently increased in the last few decades (an increase of 0.8 degree Celsius between 1960-

14. LECZs are areas located 10 meters or less above mean sea level.  
 15. World Bank Database. <https://data.worldbank.org/indicator/EN.POP.DNST?locations=NG>  
 16. See the Climate Change Vulnerability Index in <https://www.maplecroft.com/risk-indices/climate-change-vulnerability-index/>

2006 on a national level), turning Nigeria into a warmer country. Various climate-modeling exercises show that temperatures are expected to rise an average of 1–2 degrees Celsius and more during the winter. Climate models also converge on precipitations projections, which are likely to increase by 2050 for almost half the country, decrease in 10 percent of the country, and remain uncertain for one-third of Nigeria (Cervigni, Valentini, and Santini 2013).

**Oil spills, illegal refining, deforestation, soil erosion, and solid waste pollution are eroding Nigeria's natural resource base.** Intense rainfall is a serious threat for the highly friable soils in the southern states, partly causing thousands of large gully systems and severe landslides.<sup>17</sup> In the north of the country, droughts and desertification are the most urgent environmental challenges.

**Nigeria's coastline is 853 km long and harbors approximately 50 million people (26 percent of total population).** Almost all export revenues in the country come from the coast, mostly as a result of oil and gas exploration and exploitation in the Niger Delta. Nigeria is among the top ten most vulnerable coastal countries in the world. Major events like flooding have already affected Nigeria's economy and population, such as the 2010 and 2012 floods that displaced over 2 million people over and above the more than 7 million people affected by the floods (2012) (World Bank 2020c).

**Coastal trends affect cities in different ways, with Lagos experiencing erosion while the Niger Delta is mostly an area of accretion.** Sediments transported by the Niger River are deposited in the flat delta. In the short term, flood risks are more from intense rainfall than from sea level rise, though in the medium-term Lagos is highly exposed to sea level rise. On average, between 1971 and 2005, rainstorms have become less frequent but more intense in Lagos. As Lagos has expanded outward, lower income residents are residing in precarious and flood prone areas on the fringes of Lagos Lagoon. Beyond Lagos, Port Harcourt is one of the most vulnerable areas globally to the dual effects of rapid urban expansion and flood exposure.

### 2.3.2 Climate impact on key sectors

#### Crops

**Most of the agriculture is rain-fed in Nigeria, making the country particularly sensitive to climate change.** According to a 2013 World Bank report on Nigeria, the likely impacts of climate change in Nigeria include a long-term reduction in crop yields of 20–30 percent, declining productivity of livestock with adverse consequences on livelihoods, increase in food imports (up to 40 percent for rice long term), worsening prospects for food security particularly in the north and southwest, and a long-term decline in GDP of up to 4.5 percent (Cervigni, Valentini, and Santini 2013). For some areas in the northern part of the country, the decline in yields in rainfed agriculture could be as much as 50 percent for some crops (World Bank 2019a). The scenario analysis conducted in 2013 by the World Bank report indicate that on an Agro-Ecological Sub-Zonal (AESZ) and crop type basis, climate change will have the following agricultural fallouts:

1. Cereals yield reduction in the short term (2006–35), which will accelerate in the medium term (2036–65);
2. Reductions projected for sorghum, millet, maize, and rice in 2020, probable in all AESZs;
3. Rice will be particularly vulnerable in the north, with longer-term reduction in yields of 20–30 percent or more;
4. By 2050 the probability of lower yields in all cereals in all AESZs is very high; and
5. Yield declines are projected for all AESZs for root crops, cassava, and yams by 2050.

**Climate change will challenge Nigeria's goal of food security and a competitive agricultural sector.** States in semi-arid areas like the Adamawa State are particularly vulnerable to climate change. The state has experienced serious droughts, shortening rainfall, and floods that have brought low agricultural yields and negatively impacted the state's agricultural productive capacity. According to the Food and Agriculture

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17. There is an estimated 3000 gully systems in southern Nigeria (World Bank 2012).

Organization of the United Nations (FAO) Climate Smart Agriculture profile for the state of Adamawa, a 1 percent increase in minimum temperature leads to 3.7 percent reduction in rice production in Adamawa (FAO and ICRISAT 2019). Similarly, 11 percent of the arable land would be affected by climate change, causing a drop of 16 percent in the state's agricultural GDP (FAO and ICRISAT 2019). The state of Borno in the extreme north-east is also prone to the effects of climate change (decrease in rainfall and increase in temperature), which is likely to affect agriculture negatively. Dry spells together with pest infestations can affect crop development. For example, an increase in temperature of 1 degree Celsius implies that the temperature in more than two-thirds of the state of Borno would be above the optimal for both crop and livestock production (FAO and ICRISAT 2019).

**Nigeria is also experiencing serious land degradation mostly as a result of deforestation, soil erosion, waste pollution, illegal refining, and oil spills.** However, climate change and more variable and intense rainfalls would exacerbate the situation, especially in southern states with highly friable soils, as shown by the high number of large gullies and severe landslides (World Bank 2012).

**Floods occur in several parts of the country, resulting in damage to farmland, infrastructure, and livestock, and displacement of populations.** Combined with conflicts and low crop prices, these factors could lead to reduced land area under cultivation and diminished harvest prospects in affected areas. The population living along major floodplains would be affected and crops, which thrive along floodplains like rice, maize, and vegetables, would be damaged.

### *Livestock*

**Livestock development is an important component of Nigeria's agriculture and feeds a large proportion of the population (meat, milk, eggs).** With an official estimated cattle population of 20 million, Nigeria is the largest livestock producer in the ECOWAS region, and home to the largest number of pastoral producers. Livestock contributes around 1.7 percent to the national GDP and around 9 percent to the agriculture value added (FAO 2019). About 60 percent of the ruminant livestock population is found in the country's semi-arid zone and mostly managed by pastoralists. The Fulani are the primary pastoral group in Nigeria with a population of approximately 15.3 million and they constitute the core of traditional pastoralists (90 percent of cattle are owned by the Fulani group in Nigeria). Benefits of livestock production include source of farm energy, transportation, and manure. Livestock production is predominantly practiced on a small scale, using semi-intensive/extensive husbandry systems (with a few fully industrialized farms).

**However, livestock industry development is constrained by low productive breeds, inadequate access to feeds and grazing lands, frequent farmer–pastoralist conflicts, lack of processing facilities, and low value addition and low technical inputs in the management of the animals, including diseases.** Livestock is already exposed to thermal stress. As a result, domestic production of livestock products is far below the national demand, resulting in large imports of livestock and livestock products, in particular for milk and meat (World Bank 2020b).

**Given Nigeria's projected future population growth, in particular in urban areas, the demand for livestock products will rise dramatically.** Projections suggest that poultry, beef, and milk consumption will grow by 253, 117, and 577 percent respectively (FAO 2018). The consumption of eggs is expected to grow by 195 percent between 2015 and 2050 (FAO 2019). An altered rainfall pattern and increasingly frequent extreme weather events will make livestock production even more challenging. Under climate change conditions, meeting the increase in demand for livestock products would lead to more imports (in particular rice), diminished food security, and a long-term fall in GDP.

**More research is needed to evaluate the link between livestock production and climate change, but a number of recent studies indicate that climate variability has been significant in influencing livestock production in Nigeria.** Future climate change (high variability of extreme events) will likely lead to net decrease in yield of grain (and price impacts) and in forage and pasture crops for livestock. It will also likely result in changes in the epidemiology and dynamics of livestock diseases, pests, and vectors. These stressors imply greater challenges on livestock production in terms of well-being, reproduction, and performance (Nwosu and Ogbu 2011).

**Due to the susceptibility of livestock to heat, heat stress accounts for the most direct effect of climate change on livestock production** (reduction in feed intake, body weight, growth and development, drop in milk production and quality, reduced liveability, reproductive efficiency, susceptibility to infections and diseases, and impact on production cost). The impact of flooding (in Jigawa and Zamfara states), gully erosion (in Anambra, Edo, and other coastal states) and drought (in the Chad basin and northern states) has contributed to a reduction in crop production, harvest quality, and the residual feedstock from integrated crop–livestock farms while also creating grain scarcity (Uyigüe and Agho 2007). Further, the impact of drought, reduced rainfall, and forage has resulted in the extension of the grazing period of most nomadic herdsman in other regions, leading to clashes between herdsman and settlers (especially farmers whose crops are damaged by the grazing cattle) in their migrating path.

**Nigeria's efforts are to improve the performance and sustainability of livestock production and value addition in order to meet the domestic demand and export quality food products according to the National Livestock Transformation Plan (2019–2028).** A key intervention is the establishment of ranches, aimed at mitigating the escalating crisis between settled farmers and pastoralists that could undermine the entire development of the livestock sector.

### *Fisheries*

**The fisheries subsector is an important source of animal protein for the population (World Bank 2020c).** Fish is an important dietary element for many Nigerians with an estimated annual per person fish consumption of 13.3 kg in 2013.<sup>18</sup> In 2015, the total fisheries production was estimated at 1,027,000 tons, to which marine catches contributed 36 percent, inland waters catch contributed 33 percent, and aquaculture 31 percent.<sup>19</sup> The landed value in 2010 real USD value according to Sea Around Us is estimated at \$1,176,551,504 for Nigeria, one of the highest values among African countries (World Bank 2019d). Yet marine and freshwater fisheries and aquaculture are underdeveloped, with fisheries representing only 0.5 percent of GDP in 2015 thus leading to substantial imports of fish.<sup>20</sup>

**Climate change affects the nature and characteristics of water resources (marine and inland) on which many Nigerians depend.** Climate change will pose a great risk to Nigeria's national economy through its impact on fisheries (along with the Horn of Africa and parts of West Africa).<sup>21</sup> According to the World Bank 2019 report on marine fisheries in Africa, Nigeria will experience a drop of 33.82 percent and 52.75 percent in Maximum Catch Potential (MCP) under high greenhouse gas (GHG) emission scenarios, by 2050 and 2100 respectively (Dynamic Bioclimate Envelope Model). Sea level rise and extreme weather will also impact the ability to fish, in particular as a result of severe flooding. Severe storms will threaten fishing vessels (Ekene and Emodi 2016). The viability of inland fisheries is also threatened by increased salinity and shrinking rivers and lakes (Ekene and Emodi 2016; Nigeria Federal Ministry of Environment Special Climate Change Unit 2011). Finally, fisheries could be impacted by the potential loss of mangroves, which provide a sanctuary for fish reproduction, as a result of sea level rise.

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18. See the Fishery and Aquaculture Country Profiles for Nigeria: <http://www.fao.org/fishery/facp/nga/en>

19. See the Fishery and Aquaculture Country Profiles for Nigeria: <http://www.fao.org/fishery/facp/nga/en>

20. See the Fishery and Aquaculture Country Profiles for Nigeria: <http://www.fao.org/fishery/facp/nga/en>

21. See the Fishery and Aquaculture Country Profiles for Nigeria: <http://www.fao.org/fishery/facp/nga/en>

## Forestry

**Nigeria's forest cover is declining due to land conversion to agriculture and illegal harvesting for wood fuel and charcoal.** Nigeria's annual rate of deforestation stands at 4 percent, which is one of the highest rates in the world and equivalent to the loss of 410,000 hectares of forest annually (World Bank 2020c). Estimates put 64 percent of Nigerian land at risk of desertification, affecting directly or indirectly about 64 million people (Olagunju 2015). Livestock are often considered a major contributing factor to this trend.

**Climate change also affects the forestry sector in Nigeria.** Persistent flooding and water logging could make coastal forest regeneration more difficult. On the other extreme, the savannah biome of northern Nigeria would be very vulnerable to a reduction in rainfall in the region. This could result in degradation of habitats and the intensification of desertification.

**Erosion and excessive wind reduce the amount of forestry produce, such as wood and cane, consequently reducing income and increasing the costs of building and furniture materials (Ogbuabor and Egwuchukwu 2017).** The cost of deforestation and losses in non-timber forest products in Nigeria has been estimated at approximately 1.7 percent of gross domestic product in 2003 (Abdulkadir, Lawal, and Muhammad 2017; Ogbuabor and Egwuchukwu 2017).



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## Chapter 3

# Modeling Results: Future Internal Climate Migration Patterns and Trends

### 3.1 CLIMATE IMPACT PROJECTIONS<sup>22</sup>

**Figures 3.1–3.3 present the average projected changes in water availability, crop production, and net primary productivity (NPP) respectively for the 2010–2050 time period.** Appendix A has projections from 2050–2100. NPP is only used to gap-fill areas where there is no crop production.<sup>23</sup> These projections represent the inputs for the estimation of future population shifts induced by climate change as a proxy of climate migration.

**In spite of noticeable differences between models with regards to water availability, results show a wetter trend in Nigeria in particular in the north/north-east regions compared to the rest of the country, and generally modest shifts elsewhere (Figure 3.1).** Under the IPSL-CM5A-LR global climate model coupled with the WaterGAP hydrological model there is modest drying along the western border with Benin, with declines of 10–30 percent. This runs opposite to the historical trend, where the north/north-east regions were experiencing drought and desertification. The same models in RCP8.5 under higher emissions project notable increase in water availability especially in the north/north-east regions.

**Similar to neighboring countries, the crop models are more mixed, with the LPJmL model showing 10–30 percent declines in the middle belt of the country (away from the river basins), and GEPIC showing more mixed results including areas with increases in crop production (Figure 3.2).** These patterns persist and intensify under the same models in RCP8.5. The notable increase in water availability in the

22. Tables and figures in this chapter are based on *Groundswell Africa: Internal Climate Migration in West African Countries* (Rigaud et al. 2021a).

23. Since NPP is only used in the migration model to gap-fill areas where there is no crop production in rural areas, this does not apply to Nigeria since there is no part in the country without crop production.

north/northeast reflects increases in crop production, particularly under the GEPIC models. The NPP model outputs are shown only for information purposes (there is no part of Nigeria without crop production), but the picture is one of largely increasing ecosystem productivity, with the VISIT model showing slight declines in certain parts of the country (Figure 3.3).

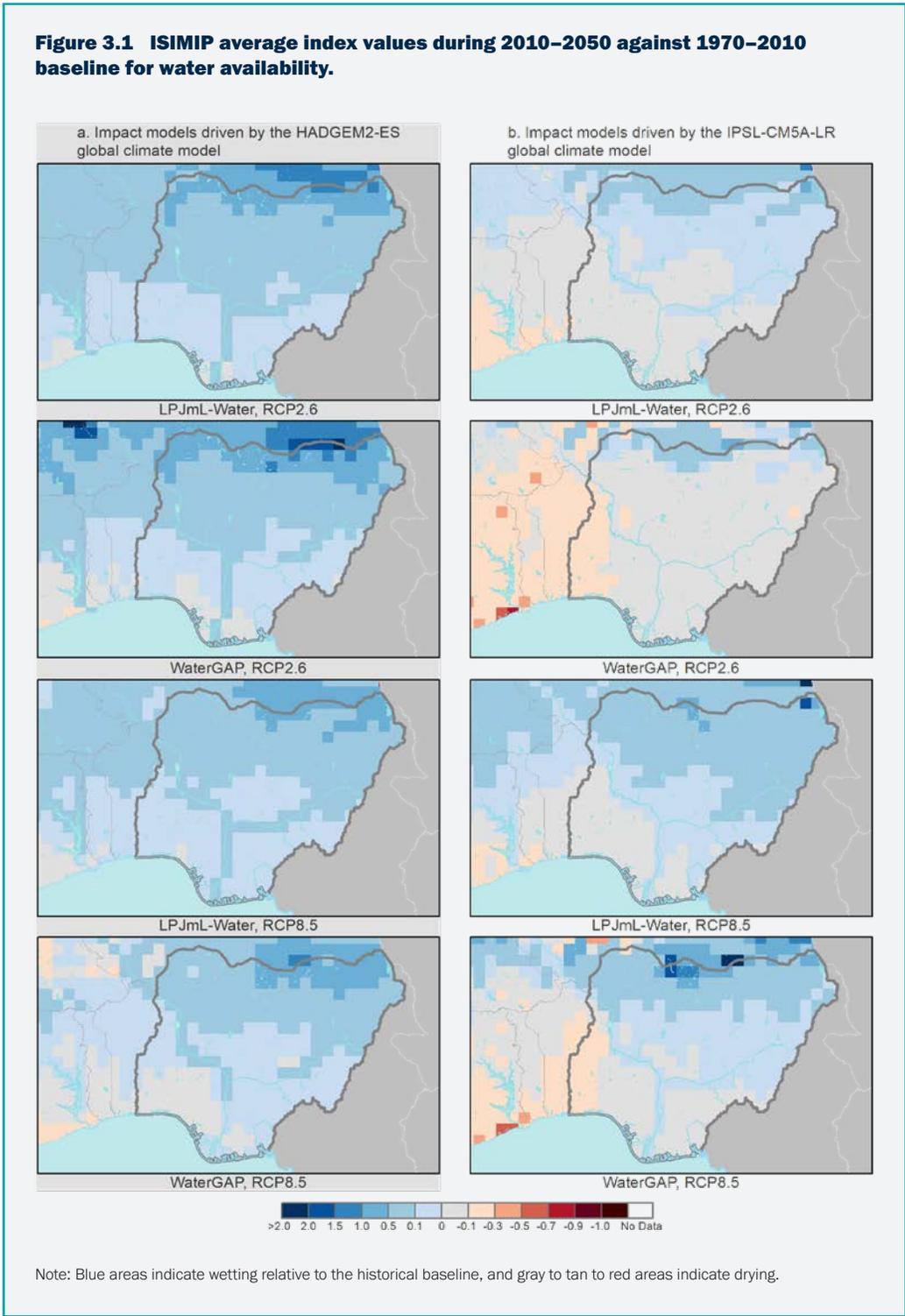
**In this work, the population gravity model calibration found that the coefficients were highest for water availability.** The coefficient for water availability in rural areas is around 2.75 times higher than that of either crops or NPP. This means that past shifts in water availability played a greater role than the other input variables in explaining shifts in population distribution.

**In addition, water availability is the only climate factor other than flood risk and sea level rise influencing future urban population distribution,** meaning that it has a far greater influence on future population distribution than most other climate variables.

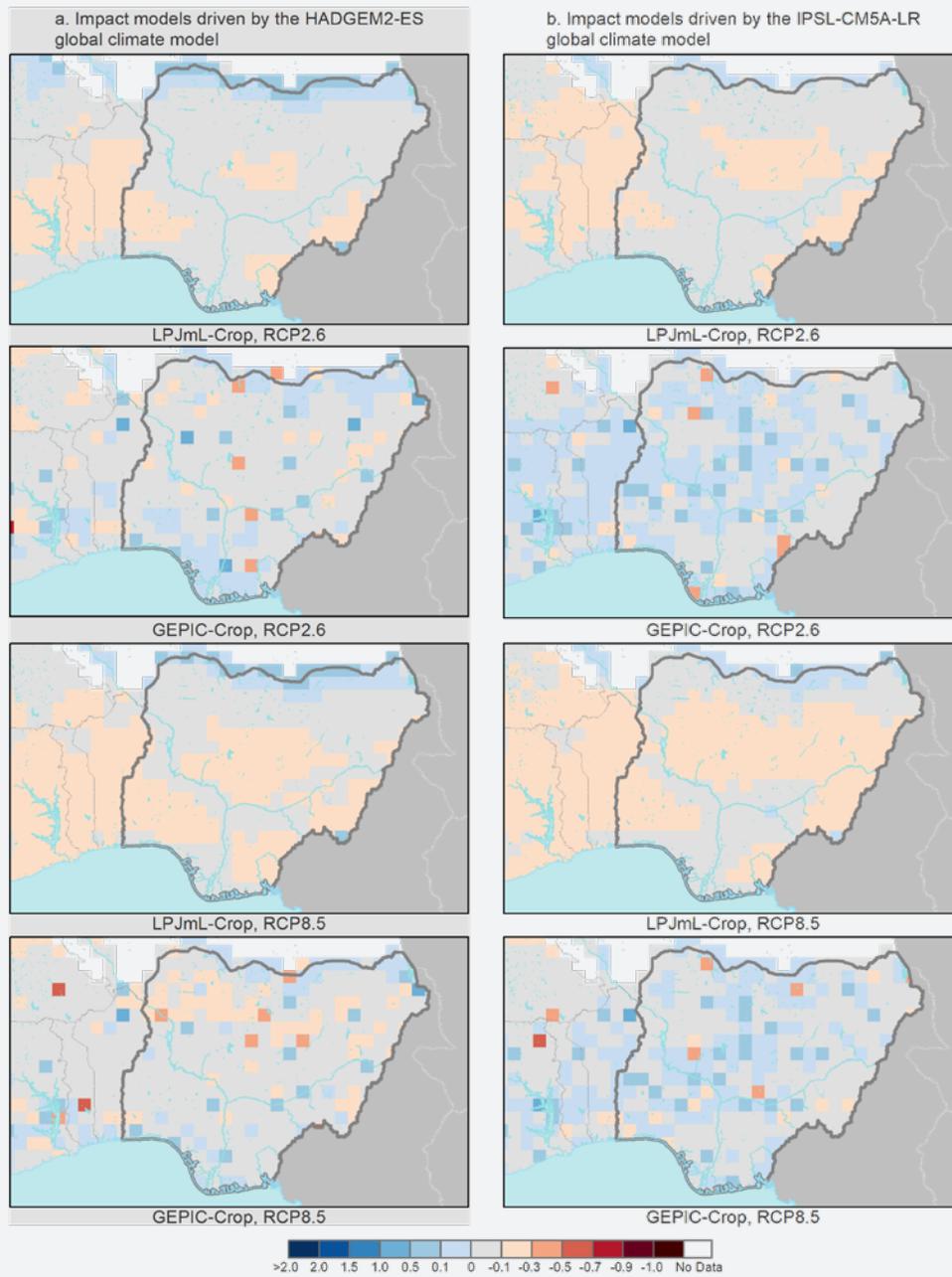


Andrea Borgarello / World Bank

Climate impacts on the water and agriculture sectors, future flood risk, and storm surges (and increasingly sea level rise) will influence future population distributions. Each of these factors influences the attractiveness of a specific area by interacting with the local environment and in turn influences population distributions. Generally, areas that see positive deviations in water and productivity also see more in-migration, as reflected through spatial population distribution shifts.

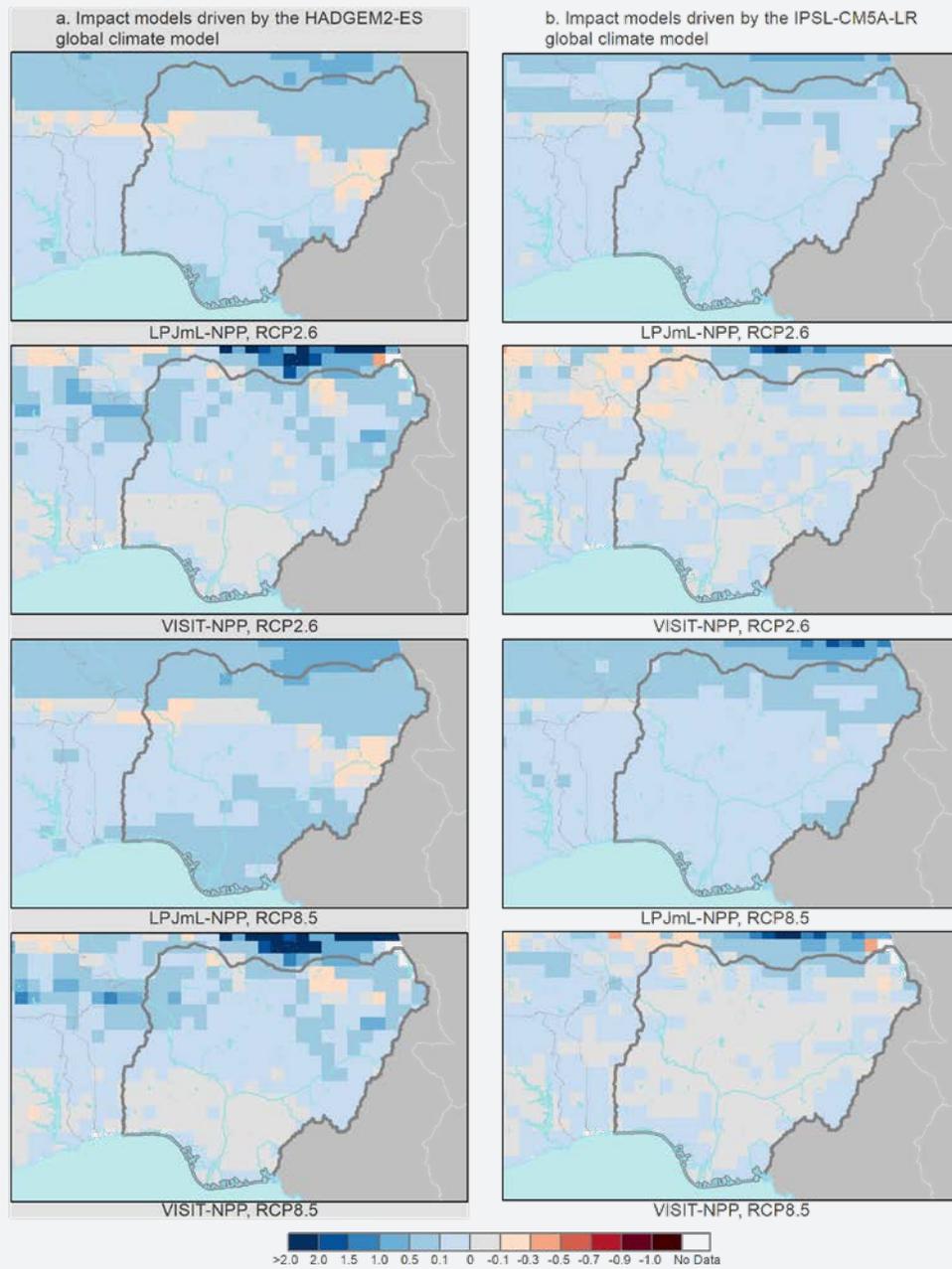


**Figure 3.2 ISIMIP average index values during 2010–2050 against 1970–2010 baseline for crop production.**



Note: Blue areas indicate increased crop production relative to the historical baseline, and gray to tan to red areas indicate decreased crop production. White areas have no crop production and are gap-filled with NPP.

**Figure 3.3 ISIMIP average index values during 2010–2050 against 1970–2010 baseline for net primary production.**



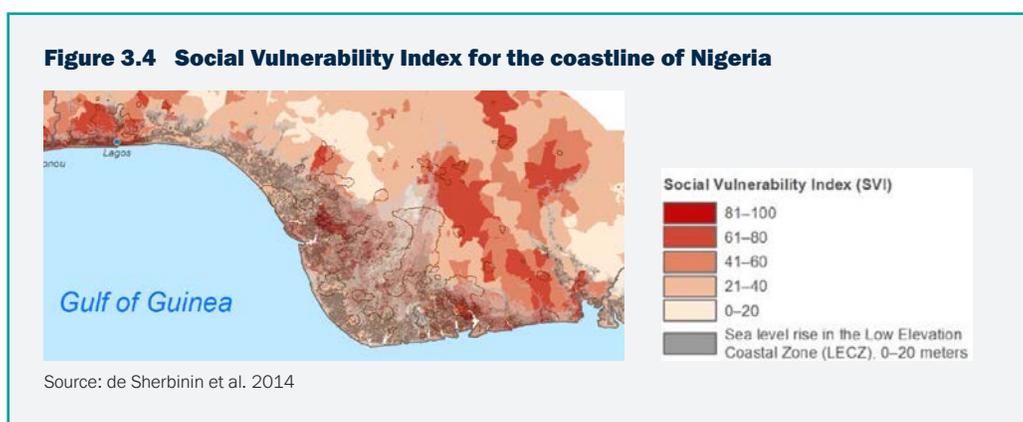
Note: Blue areas indicate increased NPP relative to the historical baseline, and gray to tan to red areas indicate decreased NPP. NPP is only used to gap-fill crop production.

## 3.2 POPULATION CHANGE PROJECTIONS

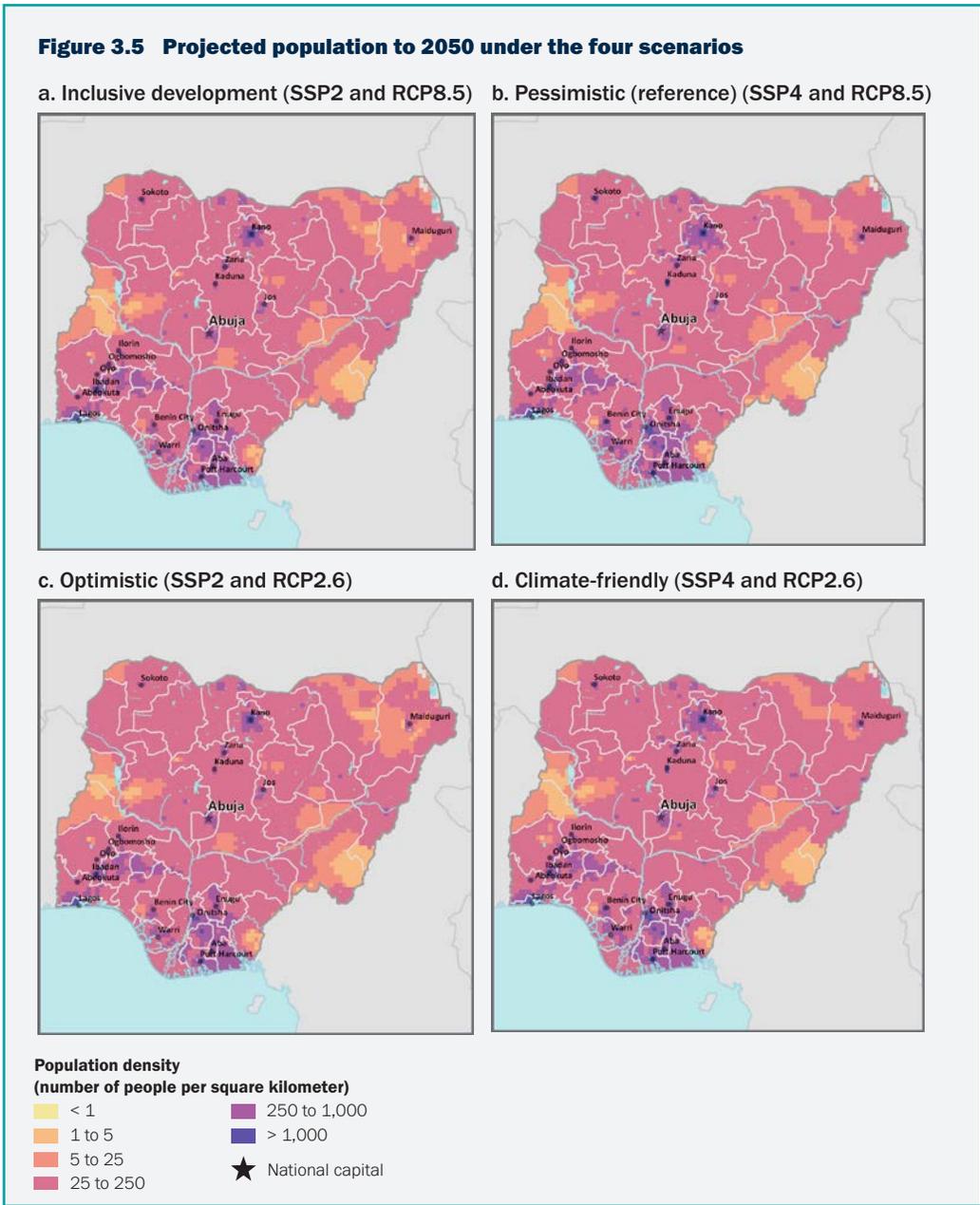
**Nigeria could see a doubling of its population from 2010 to 2050 and an intensification of its population densities over large areas.** Nigeria's population is projected to increase substantially, varying between 376.9 million inhabitants (under a SSP2 scenario) to 437.2 million inhabitants (under a SSP4 scenario). Figure 3.5 displays population density for the four scenarios by 2050. Overall, there is an accentuation and expansion of the 2010 spatial patterns (Figure 2.2) with very slight differences across the scenarios.

**High population density (above 5000 people per sq. km) is especially extended in the south, clustered around the states of Lagos and the Niger Delta including states like Akwa Ibom, Rivers, Imo, Abia, Ogun, Oyo, Osun, Ondo, and Anambra.** Areas of very high density are also visible in the center and north of the country clustered around large urban areas as Abuja and Kano respectively.

**However, the maps also reveal some patches of decline density, in some cases coinciding with natural reserves or national parks** (Kainji national park, Old Oyo national park, Okumu national park, Cross Rivers national park and Gashaka-Gumti national park).



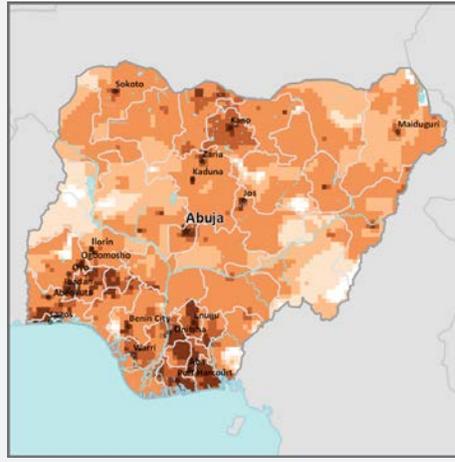
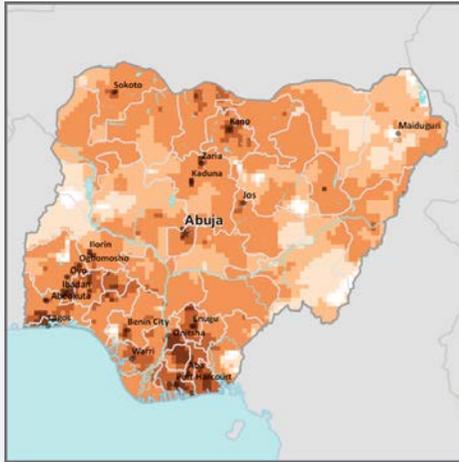
**States in the south including Lagos metropolitan area, Wari (north-west of the delta), and Port Harcourt (in the south-east) exhibit the highest levels of social vulnerability** measured as a function of population density, population growth, subnational poverty, maternal education levels, market accessibility (travel time to markets), and political violence. These areas are also low-lying and highly exposed to sea level rise (see Figure 3.4 above).



The projected change in population density of Nigeria per square kilometer is expected to increase significantly in large tracts of the country by 2050. Figure 3.6 projects change in the total population density per square kilometer between 2010 and 2050 under the four scenarios. Across the models, the projected changes in population density follows a similar trajectory with the pessimistic scenario projecting the highest increase and the optimistic scenario projecting the lowest. The biggest cluster of projected increase in population density is around Lagos and the Niger delta, upwards of 1000 persons per square kilometer, and in the north around Kano with projected density increases of 500 persons per square kilometer. Much of the rest of the country sees population increases, with the extent of increase being largest under the pessimistic scenario. Areas such as Kano, Lagos, and the Niger delta all project less extensive spread of high density in the optimistic scenario, highlighting the importance of inclusive development and low emission pathways.

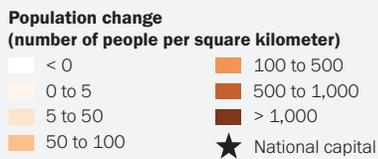
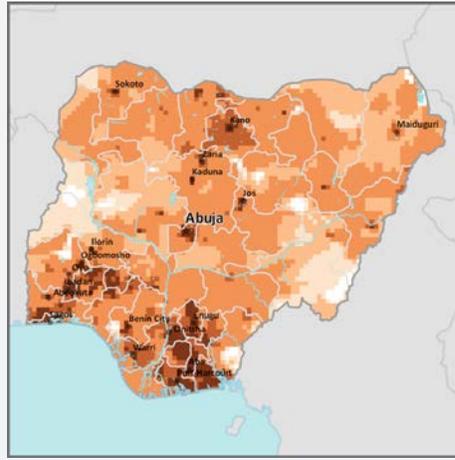
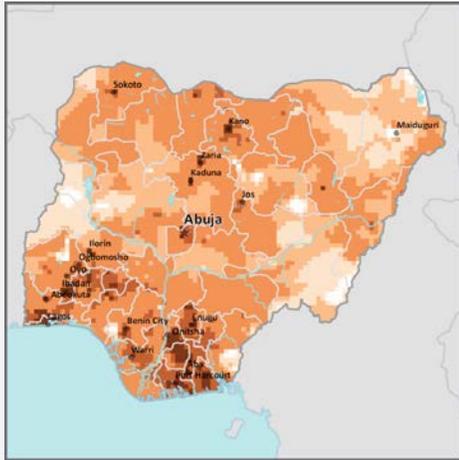
**Figure 3.6 Change in population density between 2010 and 2050 under the four scenarios**

a. Inclusive development (SSP2 and RCP8.5)      b. Pessimistic (reference) (SSP4 and RCP8.5)



c. Optimistic (SSP2 and RCP2.6)

d. Climate-friendly (SSP4 and RCP2.6)



### 3.3 INTERNAL CLIMATE MIGRATION PROJECTIONS

**This section presents the estimated number of internal climate migrants and their future locations, by comparing future population distributions under climate impacts with future population distributions under scenarios with no climate impacts.**<sup>24</sup> Population distributions have been and will, in the future, be influenced by climate impacts on the water and agriculture sectors, ecosystem impacts, future flood risk, and increasing sea level rise, all of which influence the attractiveness of a locale by interacting with the local environment. Generally, areas that see positive deviations in water and productivity also see more in-migration. Differences in population levels between scenarios that include climate impacts (RCPs) and development trajectories (SSPs) and those that only include development trajectories are interpreted as being driven by the “fast” demographic variable, namely migration. The white areas around the central trend line represent the confidence intervals, which reflect the degree of agreement among the four model runs used to provide each estimate for each scenario. Narrower confidence intervals indicate greater agreement among the model runs comprising each scenario.

#### 3.3.1 Scale and Trajectory of Internal Climate Migration

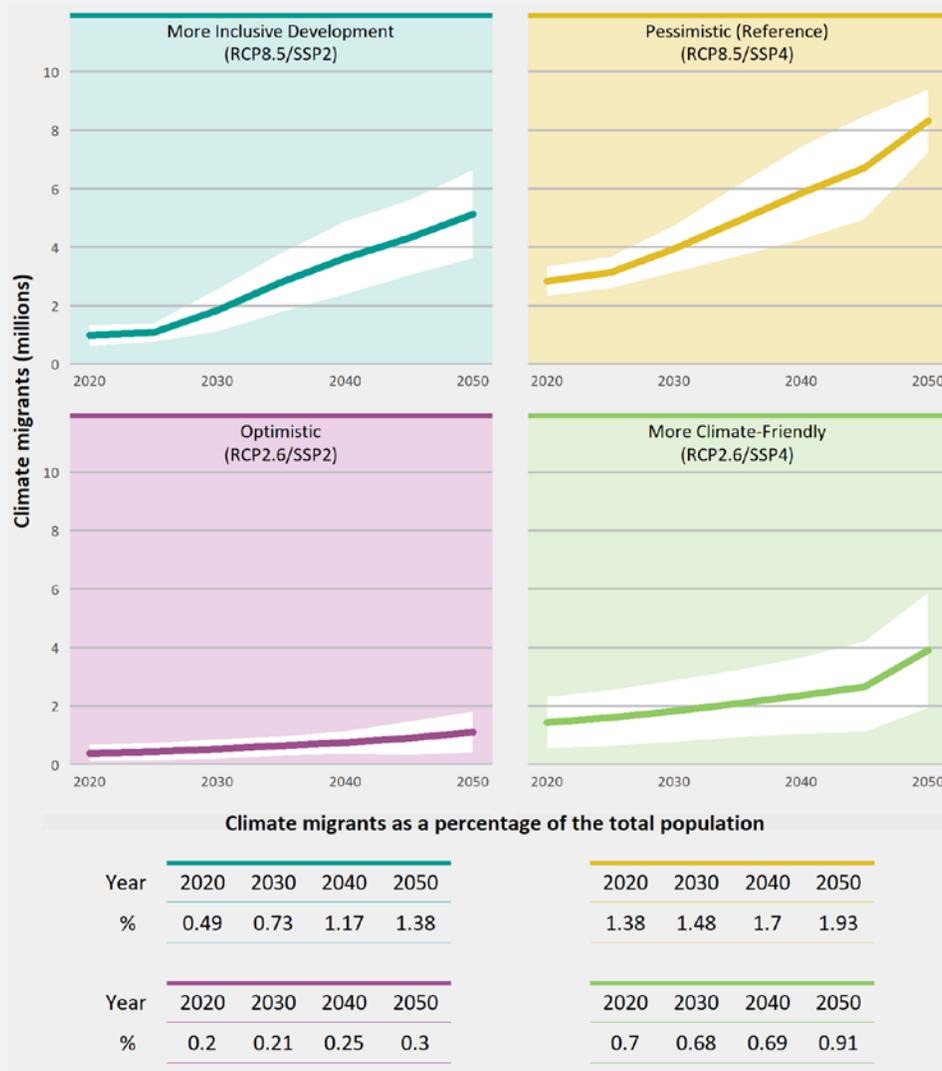
**For Nigeria, and notwithstanding variations in confidence intervals, all the scenarios display an upward trend in climate migration, but the increase is highest under the high emissions scenarios (RCP8.5).**

Figure 3.7 below presents the estimated number of climate migrants in Nigeria by scenario and decade from 2020 to 2050. Both the more inclusive development and the pessimistic scenarios have the highest average number of climate migrants projected for 2050 (5.1 million and 8.3 million respectively). Both of these scenarios also see an acceleration of the trend in 2045.

**The pessimistic scenario with an average of 8.3 million climate migrants (and a high of 9.3 million) is one of the highest numbers in the region.** Climate migrants as a percentage of other internal migrants are generally higher for Nigeria than for other countries. The optimistic scenario has the lowest average number of climate migrants projected at 1.1 million in 2050. Under the climate-friendly scenario, the average number of climate migrants reaches 3.9 million by 2050. Although this is not the lowest figure, it is the climate-friendly scenario, which exhibits the slowest increase in the number of internal climate migrants from 2020 to 2050.

24. To produce these estimates, the total populations in each grid cell for the respective no climate impact (development only) population projections are subtracted from the three spatial population projection scenarios that include climate impacts—i.e. the pessimistic reference, more inclusive development, and more climate-friendly scenarios. Then all those grid cells that have positive totals in the region are summed to estimate the number of climate migrants. Demographic variables of births and deaths are already captured within the natural population growth patterns, as part of the baseline. For details, see methodology in Appendix A of *Groundswell Africa: Internal Climate Migration in West African Countries* (Rigaud et al. 2021a).

**Figure 3.7 Total climate migrants, 2020–2050**



Note: The white areas around the central trend line represent the confidence intervals, which reflect the degree of agreement among the four model runs used to provide each estimate for each scenario. Narrower confidence intervals indicate greater agreement among the model runs in each scenario.

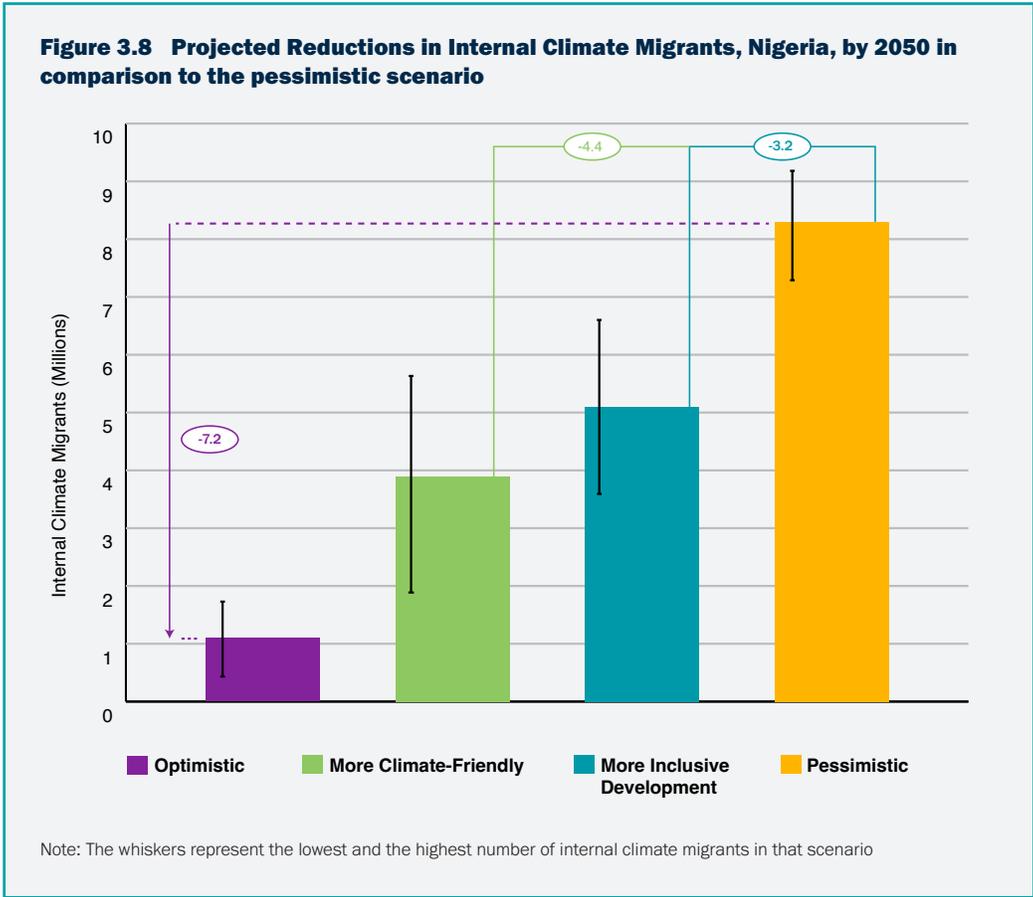
**Table 3.1 Projected Total Climate Migrants for Nigeria by 2050**

	Scenario							
	Pessimistic reference (RCP8.5; SSP4)		More inclusive development (RCP8.5; SSP2)		More Climate-Friendly (RCP2.6; SSP4)		Optimistic (RCP2.6; SSP2)	
Average number of internal climate migrants by 2050 (million)	8.3		5.1		3.9		1.1	
Minimum (left) and Maximum (right) (million)	7.3	9.4	3.6	6.6	1.9	5.9	0.4	1.8
Internal climate migrants as a percent of pop	1.93		1.38		0.91		0.3	
Minimum (left) and Maximum (right) (percent)	1.68	2.18	0.98	1.79	0.45	1.37	0.12	0.49

While there is some level of uncertainty, policies based on equitable development and low emissions can reduce the number of climate migrants in Nigeria by more than 80 per cent (Figure 3.8, Table 3.1). The scenarios with reduced GHG emissions (RCP2.6) project reductions in 7.2 and 4.4 million internal climate migrants compared to the pessimistic scenario with unequal development policies. Supporting equitable development even in a situation of high emissions can also have a significant impact by decreasing the number of climate migrants to 3.2 million. Clearly, combining equitable development policies and low emissions strategies offer the best reward for Nigeria.



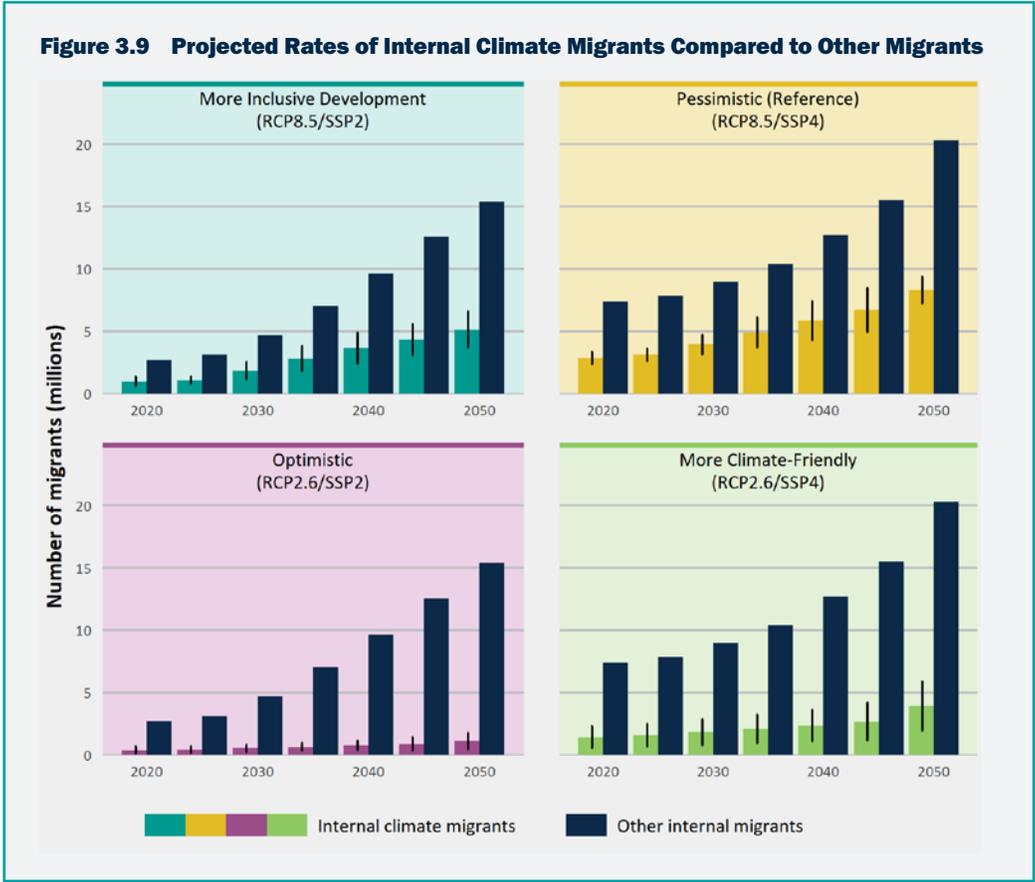
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### 3.3.2 Internal Climate Migrants vs Other Internal Migrants

**Other internal migrants include individuals who move internally due to changes in population growth, urbanization, income, and education (as set out in the SSP pathways).** The projected number of other migrants was calculated by comparing projected population distribution under the SSP-only 2050 development scenarios (no-climate) to a counterfactual in which the population in each grid cell is scaled according to the 2010 population distribution. In other words, the counterfactual is a world in which the population changes, but people remain in place. The difference between these two scenarios is considered to be development or “other” internal migrants.

**Climate migration will not occur in isolation; other types of internal migration will occur simultaneously and will need to be managed in an integrated manner in a country with already high internal mobility.** The number of other internal migrants will continue to outstrip the number of climate migrants through 2050 across all scenarios, owing to the large population growth projected for Nigeria by 2050 (Figure 3.9). However, climate migrants will increase steadily as a share of total internal migrants through 2050 across all scenarios, with the largest increase projected under the pessimistic scenario.



These projections across the four scenarios suggest that climate migration is a present reality that calls for urgent attention today. In addition, the combination of high population growth and climate change impacts could make climate migration the dominant type of internal migration in the near future. From a policy perspective, it is important that the two types of migrants (climate migrants and other migrants) are not treated as equal. The climate migrants derived from this model reflect mobility driven by the adverse impacts of climate, whereas other internal migrants move for population growth, urbanization, income, and education. Nevertheless, the response strategies may benefit from more integrative approaches in addressing the underlying factors.

### 3.4 CLIMATE IN- AND OUT-MIGRATION HOTSPOTS

Climate migration hotspots reflect areas of high certainty (with agreement across the scenarios at the top 5<sup>th</sup> percentile) that spatial populations will shift into (climate in-migration) or out of (climate out-migration) a grid cell over time. Climate out-migration will occur in areas where livelihood systems are increasingly compromised by climate impacts, while climate in-migration will occur in areas with better livelihood opportunities. These reflect movements from less viable areas with lower water availability and crop productivity and from areas affected by rising sea level and storm surges to areas with better opportunities (see box 3.1).

#### Hotspots of climate in-migration

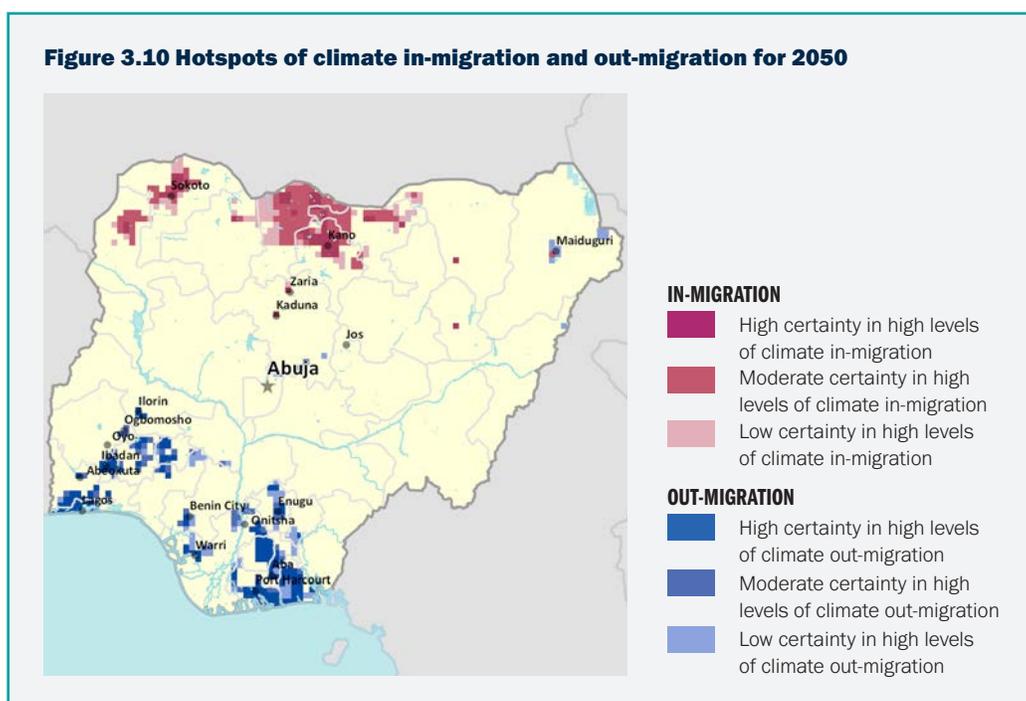
The emergence of hotspots of climate migration as early as 2030 will continue to increase in certainty and spread by 2050. Figure 3.10 presents hotspots of climate in- and out-migration by 2050, while Figure 3.11 shows hotspots of climate in- and out-migration by 2030 and 2040. Projections for 2050 indicate high-certainty levels of climate in-migration in three hotspots: in the far north near Kano, clustered in

the states of Kano, Katsina, and Jigawa; and two other hotspots located in the far north-west states of Sokoto (close to the Niger border) and Kogi (near the Burkina Faso border). The projected in-migration hotspots are situated in the rainfed croplands areas, likely in response to the projected increases in water availability and crop production along the border with Niger (see figures 3.1, 3.2).

### Hotspots of climate out-migration

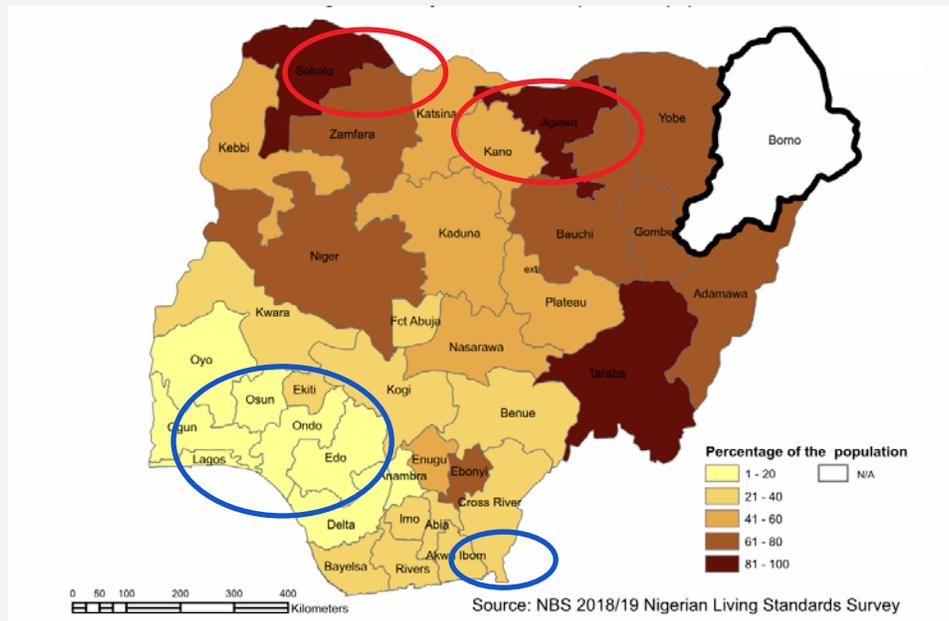
Projections for 2050 reveal high certainty in high levels of climate out-migration in the south, particularly the south-east and south-west regions. These hotspots could emerge as early as 2030 and continue to ramp up through 2040 to 2050. These climate-out migration projections run counter to the historical development-induced migration trajectory, which is towards the industrial economically booming south (Lagos, Port Harcourt) and away from the poorer, rural, and agrarian northern states. This trend is likely due to the sea level rise in low-lying areas and other coastal risks, which will attenuate population growth and encourage mobility further inland. The city of Maiduguri in the state of Borno appears to stand out as mostly an out-migration hotspot.

These climate-out migration areas coincide with both areas of low and high poverty incidence, hence cutting across the socioeconomic context. The city of Lagos, near the Niger delta, is expected to experience a noticeable decline in net climate migration due to sea level rise compounded by storm surge. Other factors such as declining water availability and crop production also play a role. However, the projection for climate-out migration applies also to areas further away from the coast in cities such as Abeokuta, Ibadan, Oyo, and Ilorin in the south-east states. These are areas with dense settlements but with low poverty levels.





**Figure 3.12 Poverty headcount rate by state**



Source: Nigeria National Bureau of Statistics 2020.

### Box 3.1 Understanding Climate In- and Climate Out-migration hotspots

**To map climate change-induced migration, population distributions are projected with and without climate impacts.** The differences between the two are interpreted as changes in population due to migration. Hotspots represent the top 5th percentile of the distribution of total climate migrants per 15 km grid cell. Where two out of four scenarios overlap, it is considered a low certainty hotspot; where three out of four scenarios overlap, this is considered a moderate certainty hotspot; and where four out of four scenarios overlap, this is considered a high certainty hotspot. To be consistent across the time series, we apply the 2050 5th percentile population difference thresholds for 2030 and 2040. This gives a sense of the progression of hotspots over time.

**More highly populated areas are more likely to have high in- or out-migration, since thinly settled areas typically do not see a lot of difference in absolute numbers of population between the climate and no climate impacts model runs.** Even though an area may represent an out-migration hotspot (in blue, figures 3.10 and 3.11), that does not mean that population will decline in these areas. Given the rapid population growth in the region, very few areas will decline. Rather, the correct way to interpret this is that population growth will be dampened owing to climate impacts, particularly on water availability but also on the agricultural (crop and livestock) sector.

**Table 3.2 High-intensity climate in-migration and out-migration hotspots by 2050**

States	Hotspots	Decade as high-intensity hotspot	Climate context	Current development context
<b>CLIMATE OUT-MIGRATION</b>				
Lagos (southern)	Lagos	2030	Lagos experiences a tropical savanna climate and there is a significant precipitation difference between the wet season and the dry season. The topography of Lagos is dominated by its system of islands, sandbars, and lagoons. Because of land reclamation efforts over the years, some of the original main islands are no longer true islands. A system of bridges connects some of Lagos's islands to each other and to the mainland. All the territory is low-lying.	A former federal capital, it is the major seaport and airport, the dominant financial and economic center for education, and an economic free zone. Lagos continues to pull major migration streams. One of the economic powerhouses of Nigeria, Lagos is at increasing risk of flooding (World Bank 2020c).
Ogun (southern)	Ogun	2040	It is covered predominantly by tropical rain forest and has wooded savanna in the northwest.	With a population of 7.1 million in 2016, <sup>25</sup> the Ogun state serves as the major corridor for transportation of goods, services, and people between the nation's commercial center Lagos and the rest of the country as well as the large West African markets. The state is the largest producer of cement in the country with 13 million metric tons per annum (Nigeria National Bureau of Statistics 2018). It is a coastal state bordered by Benin in the west (Ogun and Yewa rivers). Agriculture, the economic mainstay of Ogun, produces rice, corn (maize), cassava (manioc), yams, plantains, and bananas. Ogun State is noted for being the almost exclusive site of Ofada rice production.
Rivers (southern)	Rivers	2030	Rivers is located in the southern part of the country near the coast prone to wildfires (USAID 2019).	Rivers faces high exposure to future coastal flooding due to low elevation. Home to the city of Port Harcourt with its population of nearly 2 million (USAID 2019).
Akwa Ibom (southern)	Akwa	2040	Rainfed cropland with extensive saltwater mangrove swamps along the coast and tropical rain forests and oil palms farther inland.	Population estimated at than 5 million people in 2016 (Nigeria, National Bureau of Statistics 2018). Akwa Ibom State Average Growth Rate is estimated at 3.2 percent. <sup>26</sup>

25. Ogun State Government Official Website. Retrieved June 21, 2021. <https://www.ogunstate.gov.ng/ogun-state/>

26. Akwa Ibom official state website. <https://akwaibomstate.gov.ng/about-akwa-ibom/>. Retrieved June 23, 2021

## CLIMATE IN-MIGRATION

Kano (northern)	Kano	2030	Kano has a tropical savanna climate. Faces chronic aridity.	One of the most populous states in Nigeria (after Lagos). Kano is the commercial and investment hub of Northern Nigeria and the largest non-oil and gas economy in Nigeria, with a GDP of approximately \$12 billion. <sup>27</sup> The Kano economy is driven largely by commerce, manufacturing, and subsistence agriculture—the dominant activity, with up to 70 percent of the population engaged directly or indirectly in it. Numerous small and medium-size enterprises across all economic activities, contributing approximately 60–70 percent of output and employment. Kano is the highest producer of groundnuts in the country. Kano State is the second-largest industrial center after Lagos State in Nigeria and has historically been a major commercial and manufacturing entry port and hub in the West African sub-region.
Katsina (northern)	Katsina	2030	The State extends from the tropical grassland known as the Savanna to arid zone to the North. Like any other part of the tropics, there are two main seasons: wet and dry season. The rainy season is longer in the southern part of the State where it lasts up to five months, while in the northern part of the state it lasts for four months. Faces chronic aridity. Like most States in the western part of the country, Katsina is highly sensitive to climate change in terms of crop production (World Bank 2020a).	Agrarian economy with a cultivable 2.4 million hectares of land, out of which 1.6 million is under cultivation (World Bank 2020a). About 80 percent of the population of the state depends on farming and rearing of animals (World Bank 2020a). The state is a major collection center for cash crops such as cotton and groundnuts and food crops such as maize, guinea corn, millet, and vegetables. Largest producer of cotton in Nigeria and second largest producer of sorghum and sugarcane (World Bank 2020a). Ranked 6th in starting a business in 2018. <sup>28</sup> The average GDP per capita is \$6,022 and the state represents 4 percent of Nigeria's total population. <sup>29</sup>
Sokoto (northern)	Sokoto	2040	Faces chronic aridity and also riverine flooding along the Sokoto and Komadugu river systems (USAID 2019).	State with one of the highest poverty incidence levels in the country, the poverty headcount rate reaching close to 88 in Sokoto (Nigeria Bureau of Statistics 2020).

### *Beyond the hotspots—the larger spatial context*

**Climate-induced spatial shifts—as a proxy for climate migration—are not confined to hotspots.** The population change per square kilometer owing to climate migration is projected to be positive in the north, north-west and south, and negative in south and central parts of the country with some variations across the four scenarios by 2050. Figure 3.13 displays the projected population change per square kilometer owing to climate migration by 2050—the difference between the climate and no climate impacts scenarios. This reinforces the climate in- and climate out-migration hotspots (Figure 3.10) while also reflecting the population shifts across the territory of Nigeria. The projected movement away from coastal belt in the coming decades could be explained by sea level rise impacts compounded by storm surge on the coast, and increase in water availability inland. The areas of negative population change per square kilometer do not imply a decline in the total population. Instead, this reflects an attenuation of population change as a consequence of spatial shifts driven by climate factors or climate migration. The modeling uses geospatial processing to exclude from consideration protected areas or places where the terrain is too rugged to inhabit. The effect is that the algorithm is not applied in these areas.

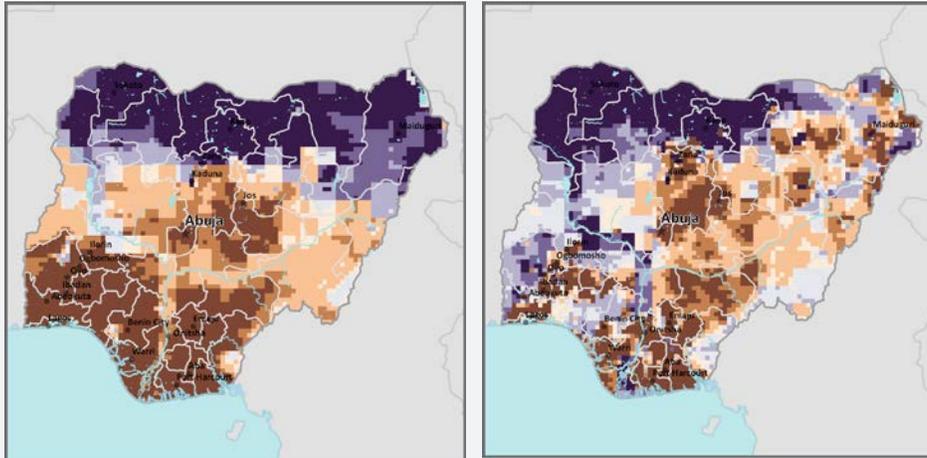
27. Kano State Government Official Website. Retrieved June 21, 2021. <https://www.kanostate.gov.ng>

28. World Bank Doing Business portal: <https://www.doingbusiness.org/en/data/exploreconomies/nigeria/sub/katsina>

29. Katsina State official website. Retrieved June 21, 2021. <https://www.katsinastate.gov.ng/invest/investment-sectors/>

**Figure 3.13 Population changes per square kilometer in 2050 owing to climate migration**

a. Inclusive development (SSP2 and RCP8.5)    b. Pessimistic (reference) (SSP4 and RCP8.5)



c. Optimistic (SSP2 and RCP2.6)

d. Climate-friendly (SSP4 and RCP2.6)

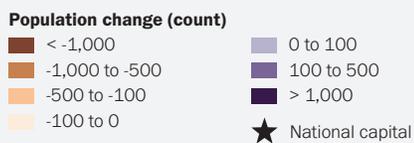
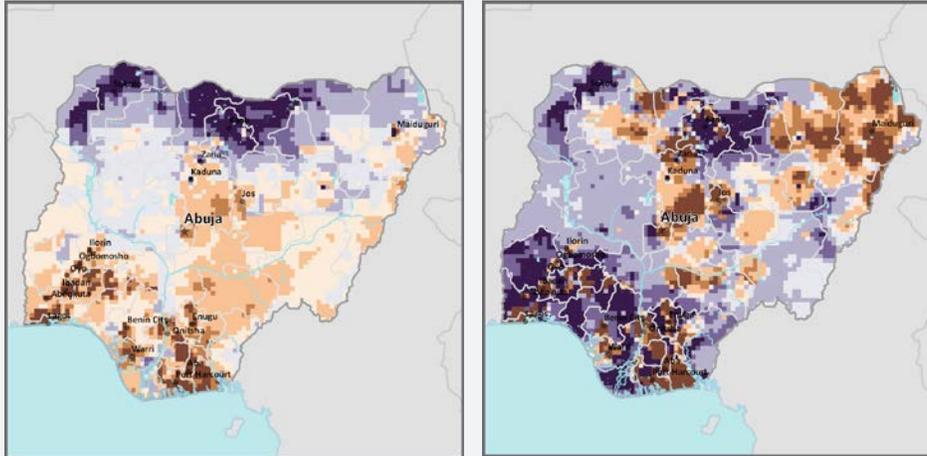
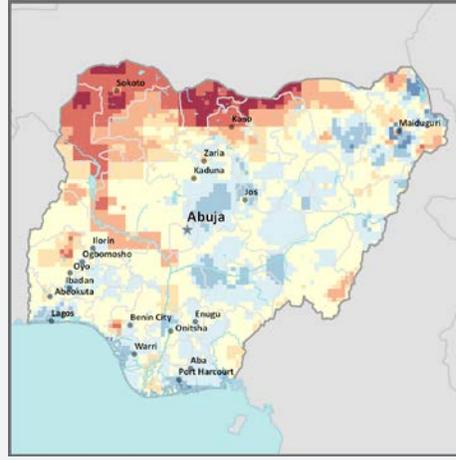
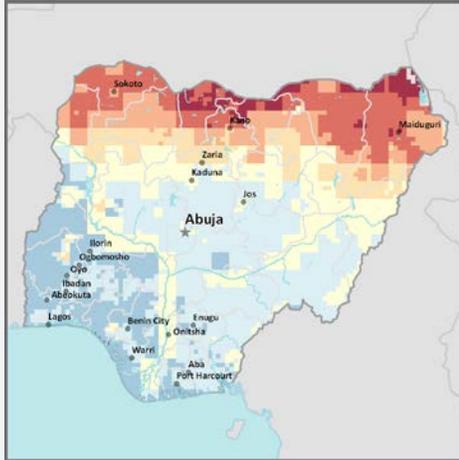


Figure 3.14 displays the information in Figure 3.13—the difference between climate impact and no climate impact scenarios—as percentage of the population under the no climate impacts (SSP-only) scenario in each grid cell.

Differences in absolute population density between the climate and no climate impacts scenarios (Figure 3.14) show a stark north-south contrast, with almost all scenarios depicting relative growth in the north and northwest, while there is a mixed signal but mostly declines in the south. These are likely due to sea level rise in the low-lying delta region. Percent changes are highest in the northern states, which coincide with absolute changes. There is a growth of population change of more than 10 percent in the high emissions scenarios in the north, while declines are mostly in the south, and as a percentage of population are more subtle (in the range of 2.5–5 percent).

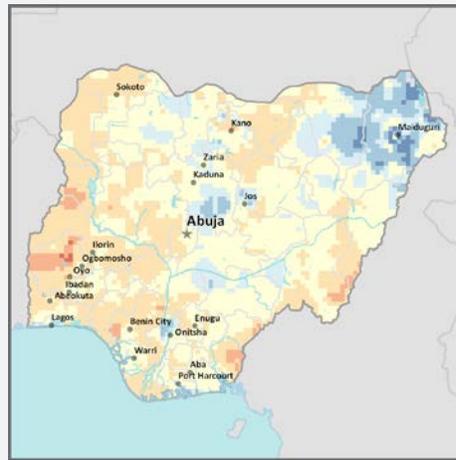
**Figure 3.14 Percentage difference in population per square kilometer in 2050 owing to climate migration, in percentage of population according to the no climate impact scenario**

a. Inclusive development (SSP2 and RCP8.5)      b. Pessimistic (reference) (SSP4 and RCP8.5)



c. Optimistic (SSP2 and RCP2.6)

d. Climate-friendly (SSP4 and RCP2.6)



**Population change (%)**

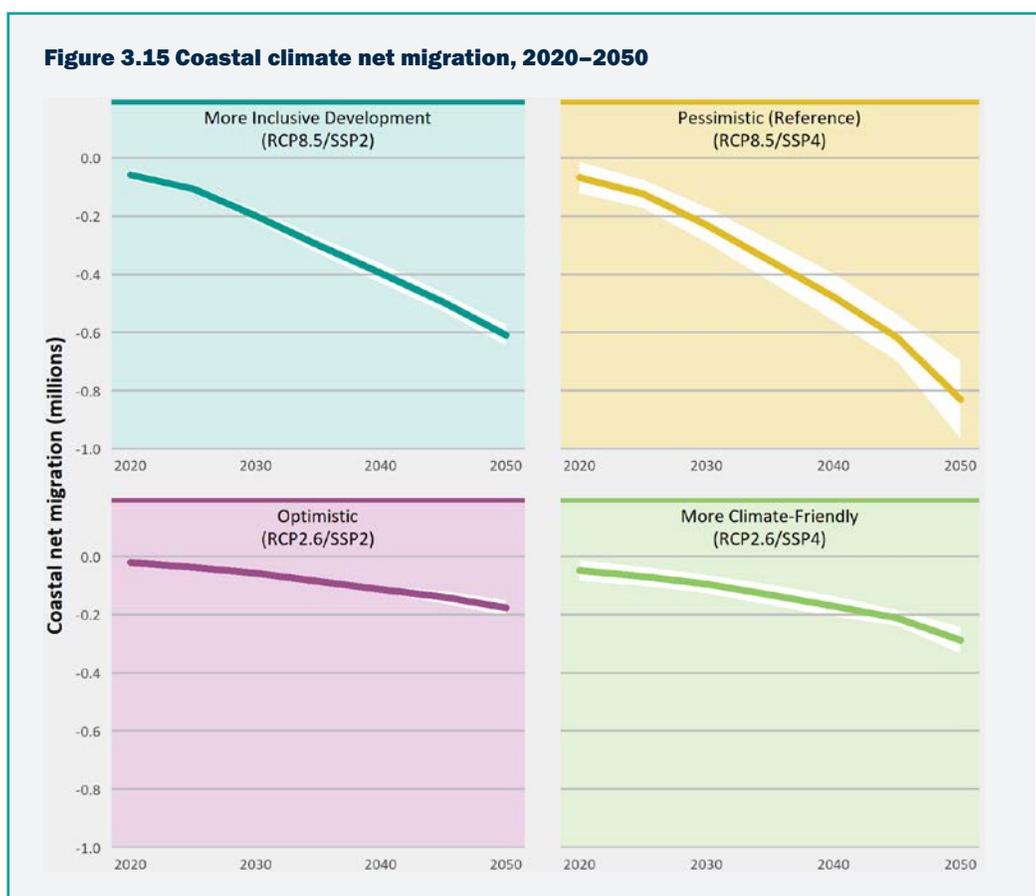


## 3.5 CLIMATE MIGRATION BY ZONE: COASTAL AREAS, LIVELIHOOD ZONES, AND STATES

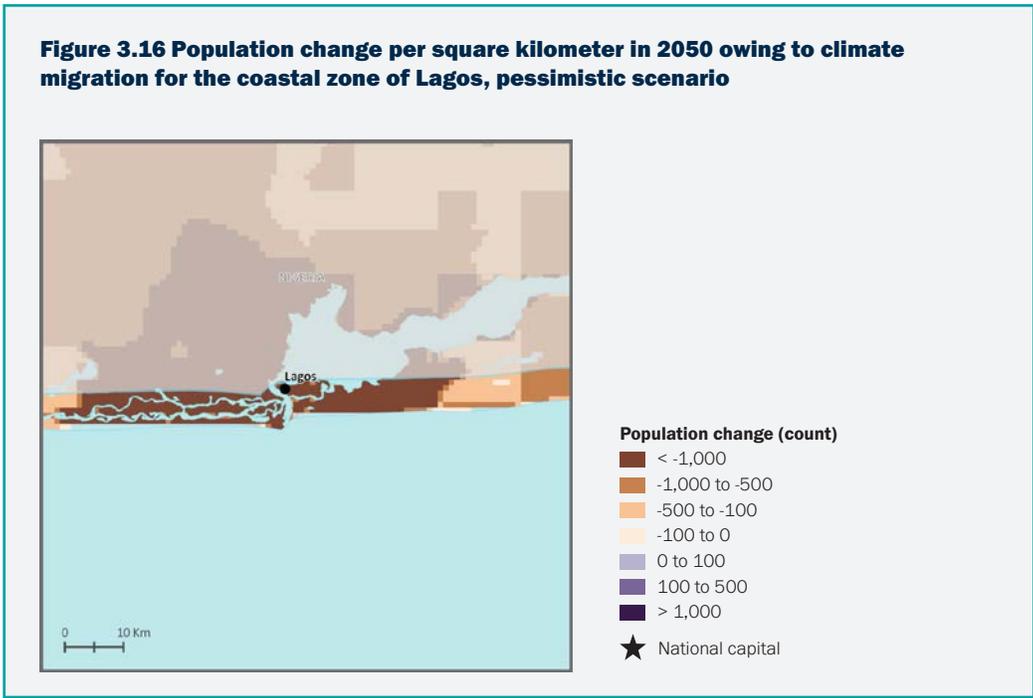
### 3.5.1 Climate migration in coastal areas

**Figure 3.15 presents the net migration out of the coastal zone, which is interpreted as the 5-kilometer strip along the coastline.** Processing of coastal migration is done here using the 1-kilometer resolution modeling outputs, not the results aggregated to 15 kilometers.

For Nigeria, modeling results for the four scenarios indicate a negative impact of climate change in coastal zones (0–5km coastal belt), with some differences in the volume and uncertainty of coastal climate migration (Figure 3.15 and 3.16). The negative balance is lowest for the optimistic scenario (0.18 million by 2050) followed by the more climate-friendly scenario (0.3 million by 2050). The more inclusive development and the pessimistic scenarios present larger negative balances (0.5 million and 0.83 million by 2050, respectively) and higher uncertainty, in particular for the pessimistic scenario. For example, under the pessimistic scenario, Nigeria could see between 0.7 million and 1 million climate out migrants from the area that is 0–5 kilometers from the coast.<sup>30</sup> These results indicate that some out-migration from the coastal areas will be not only owing to sea level rise but also to changes in water availability and crop production. However, sea level rise could attenuate but is unlikely to stop growth in the coastal zone, and many coastal “migrants” may simply move slightly inland or to higher ground. A composite anticipatory suite of interventions—on resilience, preparedness and planned relocation—is an imperative.



30. The processing is done at 1-kilometer resolution; therefore, the numbers are not comparable to country level numbers presented earlier in the report.



### 3.5.2 Climate migration by livelihood zone

Livelihood zones used here are based on an aggregation of anthropogenic biomes produced by Ellis et al. (2013 and 2010). These livelihood zones are static, meaning they are not projected into the future based on likely climate influences on ecosystems (e.g., Williams et al. 2007), but reflect the historical climate period from 1970–2010. The distribution of zones in the future could be altered by climate impacts on the water and agriculture sectors and natural ecosystems. Furthermore, livelihood zones are land-based, and therefore do not take into account livelihoods dependent on marine fisheries along the coast.

Figure 3.17 below displays the distribution of livelihood zones in Nigeria based on an aggregation of anthropogenic biomes produced by Ellis et al. (2013 and 2010). Nigeria is a country dominated by rainfed croplands. Pastoral and rangeland zones are also significant and mostly located in the middle belt (Oyo, Kwara, Kogi, Benue, and Taraba states notably). There are a few spots of rice-growing areas in states like Kaduna, Kano, Benue, Ebonyi, and Ekiti, and only 1 percent of cropland is irrigated in the country. Most of the dense settlements are located in the extreme southern/coastal part of Nigeria along the Niger delta river. There are also some dense settlements in cities located in the center and north of the country, like Sokoto, Abuja, Kano, Maiduguri, Kaduna, Zaria, and Jos. Semi-natural and wild lands can be found along the Niger delta, in Cross River and Taraba states in the south-east and in the Oyo, Kwara and Niger states in the south-west, coinciding in some cases with the existence of natural parks or reserves. The coastal zone also harbors significant mangrove forests.

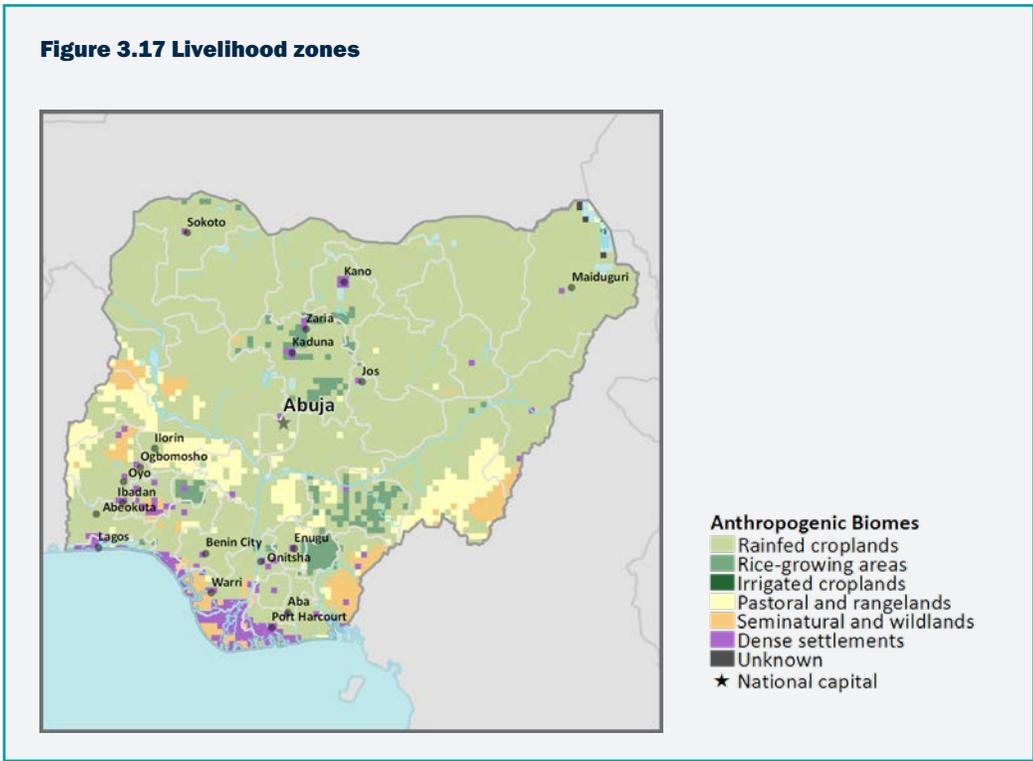


Table 3.3 displays net migration by livelihood zone under the four scenarios and by decade 2030 to 2050. Livelihoods in dense settlements consistently show negative values for net climate migration across scenarios and for each decade, whereas rainfed croplands consistently show positive values for net climate migration across scenarios and for each decade. The projection for the dense settlements is consistent with the density maps, which also show out-migration in these areas. Net climate migration in dense settlements is estimated to reach -0.23 million by 2050 under the optimistic scenario, while that figure will reach -1.28 million under the pessimistic scenario, thus highlighting the role played by a combination of low emissions and inclusive development policies. The out-migration projections from dense settlements are also consistent with the (modest) decrease in water availability in the coastal urban region shown under the models (Figure 3.1). Values for net climate migration livelihoods in pastoral land and rangelands will vary across scenarios. Except for the climate-friendly scenario, which will see a consistent increase in positive values, all the other scenarios will see a consistent increase in negative values.



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**Table 3.3 Net climate migration by scenario, livelihood zone, and decade, Nigeria**

Year and Livelihood zone	Scenario			
	More Climate-Friendly (RCP2.6/SSP4)	More Inclusive Development (RCP8.5/SSP2)	Optimistic (RCP2.6/SSP2)	Pessimistic (Reference) (RCP8.5/SSP4)
<b>2030</b>				
Dense settlements	-37,411	-264,830	-66,266	-240,439
Irrigated croplands	-282	10,800	2,301	7,994
Pastoral and rangelands	73,742	-94,380	-3,555	40,097
Rainfed croplands	-66,965	487,981	89,641	282,537
Rice-growing areas	-20,573	-90,478	-23,932	-136,139
Semi-natural and wildlands	55,473	-50,646	2,096	52,594
Undefined	-3,983	1,554	-284	-6,644
<b>2040</b>				
Dense settlements	-143,925	-562,830	-135,020	-679,243
Irrigated croplands	1,512	21,716	4,478	19,676
Pastoral and rangelands	81,262	-225,201	-22,324	-33,816
Rainfed croplands	37,507	1,062,662	195,980	925,384
Rice-growing areas	-30,105	-175,692	-34,106	-235,280
Semi-natural and wildlands	57,432	-125,104	-9,360	7,398
Undefined	-3,682	4,449	352	-4,119
<b>2050</b>				
Dense settlements	-306,512	-859,419	-233,494	-1,275,733
Irrigated croplands	2,974	30,269	7,116	31,950
Pastoral and rangelands	115,105	-331,011	-42,100	-94,691
Rainfed croplands	156,973	1,576,006	340,551	1,675,413
Rice-growing areas	-35,412	-237,211	-48,665	-268,613
Semi-natural and wildlands	72,764	-185,004	-24,288	-64,577
Undefined	-5,892	6,372	880	-3,750

**Net climate migration figures in rainfed croplands show wide variations between all four scenarios but reveal a consistent and gradual positive upward trend from 2030 to 2050 under each scenario.** This projection also matches the density maps, which show in-migration trends in these areas. By 2050, net climate migration in rainfed croplands is estimated at 0.16 million under the climate-friendly scenario (the lowest figure) while net climate migration reaches 1.68 million under the pessimistic scenario (the highest figure), showing the significant impact that a low-carbon emissions path could have. Irrigated croplands show mixed results across the scenarios but overall exhibit an upward trend from 2030 to 2050.

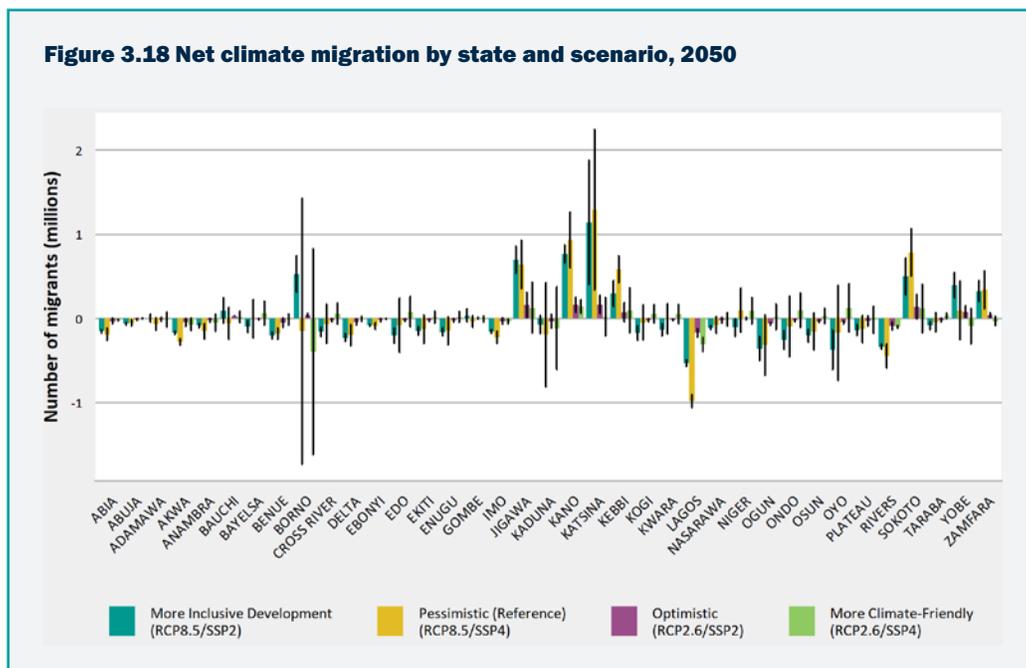
**Nigeria's climate mirrors the global climate in its complexity and division into sub climates, ranging from the arid Sahel of the north to the humid rainforest of the south and between these the derived savanna and savanna ecosystems.**

### 3.5.3 Climate migration by state

Figure 3.18 and Table 3.4 display net climate migration for 2050 by state.

Positive net climate migration is projected to occur by 2050 in all the northern border states (Kebbi, Sokoto, Zamfara, Katsina, Kano, Jigawa, Yobe), in addition to the state of Niger, under all scenarios and especially under the high emissions ones. The states of Kano, Katsina and Sokoto in the extreme north-western part of the country are projected to experience the greatest positive net climate migration compared to the other border states under a pessimistic scenario. Although the state of Kaduna is expected to see a negative net climate migration by 2050 under all scenarios, northern Kaduna (city of Zaria) represents an in-migration climate migration hotspot. The demographic variable plays a role in these patterns. Kano city also has a high sex ratio (more males than females) and a comparatively high median age of 21 compared to 16 in the surrounding rural areas. Increases in water availability by 2050 coupled with increases in crop production along the border with Niger also explain these trends.

Negative net climate migration is projected to occur by 2050 in all the southern coastal states (Lagos, Ogu, Ondo, Delta, Bayelsa, Rivers, Akwa, Cross Rivers) under all scenarios and especially under the high emissions scenarios. The states of Lagos and Ogun (extreme south-west coastal zone) and the states of Rivers and Akwa (in the Niger delta) are projected to experience the greatest negative net climate migration compared to the other southern states, in particular under a pessimistic scenario. The highest median ages in Nigeria are in the southern states, which generally serve as an attractor for population growth, but these are offset by sea level rise along the coast and declining water availability and crop production. In spite of high uncertainty band for the state of Borno, a negative net climate migration is projected for this extreme northeastern area of Nigeria, partly due to the ongoing conflict and violence with Boko Haram, with the exception of the hotspot city of Maiduguri, which exhibits mixed patterns of in- and out- climate migration.



**Table 3.4 Net climate migration by scenario and state, 2050**

States	More Climate-Friendly (RCP2.6/SSP4)	More Inclusive Development (RCP8.5/SSP2)	Optimistic (RCP2.6/SSP2)	Pessimistic (Reference) (RCP8.5/SSP4)
ABIA	-19,097	-153,980	-30,121	-188,487
ABUJA	2,527	-63,563	-7,146	-54,653
ADAMAWA	-11,813	3,537	-11,324	-66,125
AKWA	-69,952	-172,514	-44,539	-277,898
ANAMBRA	-48,767	-84,710	-21,478	-154,344
BAUCHI	17,861	93,513	31,850	-58,267
BAYELSA	63,432	-93,244	-5,783	-5,261
BENUE	-10,919	-202,050	-47,983	-181,466
BORNO	-394,865	530,644	40,129	-150,395
CROSS RIVER	58,330	-160,002	-19,285	-65,230
DELTA	-2,644	-229,350	-42,165	-198,120
EBONYI	-6,008	-85,507	-16,466	-88,116
EDO	81,688	-205,383	-19,247	-81,046
EKITI	15,721	-149,498	-22,473	-129,093
ENUGU	18,406	-162,223	-22,579	-147,846
GOMBE	-6,731	37,516	3,600	-33,401
IMO	-32,681	-155,100	-30,164	-224,916
JIGAWA	128,428	698,479	158,026	639,722
KADUNA	-116,127	-71,917	-33,432	-193,551
KANO	144,737	765,153	163,328	933,244
KATSINA	20,742	1,142,672	168,019	1,294,419
KEBBI	98,560	295,944	75,248	583,865
KOGI	56,394	-173,759	-20,760	-47,451
KWARA	52,324	-132,877	-16,444	-5,103
LAGOS	-310,204	-529,777	-169,869	-980,688
NASARAWA	-8,843	-110,470	-21,530	-76,706
NIGER	89,458	-108,769	3,785	95,876
OGUN	19,372	-359,506	-63,505	-315,436
ONDO	98,299	-254,851	-23,005	-94,937
OSUN	28,755	-204,121	-31,582	-155,611
OYO	126,505	-371,502	-44,985	-170,077
PLATEAU	-16,741	-137,869	-29,628	-128,547
RIVERS	-98,255	-337,050	-90,286	-448,152
SOKOTO	118,997	501,395	138,936	784,473
TARABA	34,351	-84,406	-19,582	-44,718
YOBE	-90,556	398,791	80,630	93,625
ZAMFARA	-30,685	326,353	41,809	340,419

### 3.6 NIGERIA AND THE WEST AFRICA COASTAL COUNTRIES

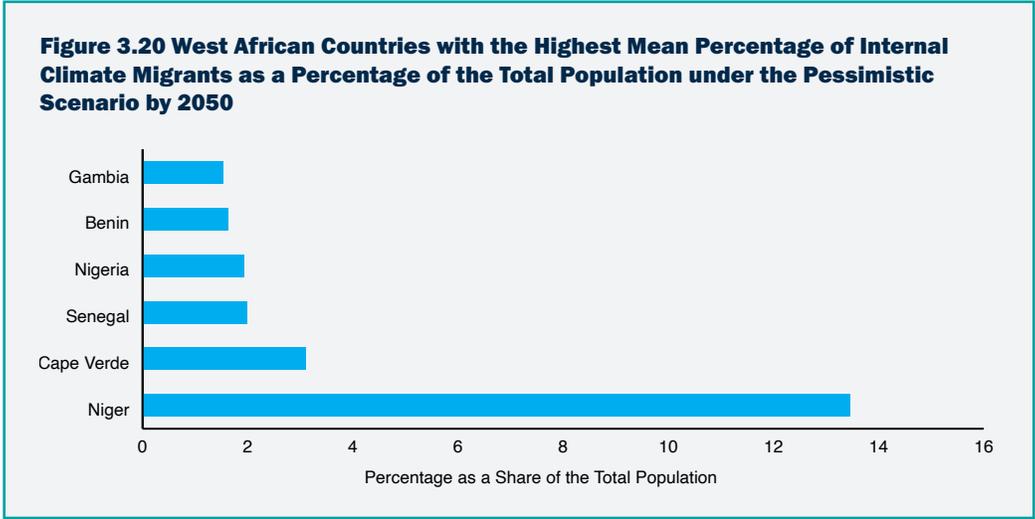
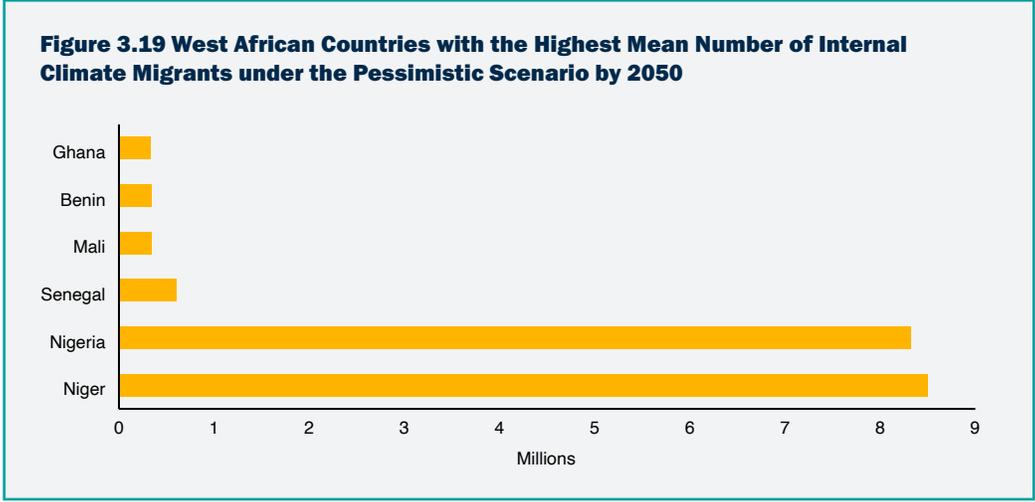
**West Africa is a highly mobile region, and it is therefore important to contextualize Nigeria's modeling results against mobility in the regional context.** Since 1979, the ECOWAS Protocol on the Free Movement of Persons, Residence and Establishment allows ECOWAS citizens: (a) to enter any ECOWAS state without a visa; (b) to reside in any ECOWAS member state for up to 90 days without a visa; and (c) to apply, after 90 days, for a permanent residence permit which allows them to start businesses, seek employment, and invest. An ECOWAS passport was established in 2000.

**Nigeria is an active member of the ECOWAS, and the country has become the largest sending and destination country for migration in West Africa due to the size of its economy and porous borders.** A total of 1.5 million international migrants living in Nigeria mostly originate from ECOWAS countries. Efforts to implement the ECOWAS Protocol are needed because only the first phase—abolishing visa requirements if the stay does not exceed 90 days—has been achieved. The right of residence, the aim of the second phase, and the right of establishment foreseen under the third and last phase have not yet been implemented. Given the free movement and connectivity among the West African countries, which has contributed to regional integration and economic development, considering the potency of climate-induced migration in the region has become an urgent task to inform planning, policy, and actions.

**Nigeria is projected to have the second highest number of internal climate migrants in West Africa (figure 3.18).** By 2050, Nigeria could have a mean number of 8.4 million internal climate migrants under the pessimistic scenario, preceded by Niger with 8.5 million. Internal climate migrants as a percentage of total population remain relatively low for most West African countries, except for Niger with a mean percentage of 13.45 by 2050 under the pessimistic scenario (figure 3.19). Cape Verde and Senegal are projected to have the second and third highest percentages, with a mean of 3.1 and 1.98, respectively, by 2050. Internal climate migration could make up a significant proportion of all migration by 2050, particularly under the high emissions scenarios, and significantly so for countries like Benin, Nigeria, Senegal. Indeed, climate migrants could make up between 25 and 35 percent of total migrants under the pessimistic and inclusive development scenarios both of which have high emission scenarios.



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**Nigeria could witness a climate in-migration hotspot in the north and contiguous with Niger, owing to projected increases in water availability and pasturage.** Proactive and collaborative management of these natural resources between those two neighboring countries will be key, in particular as the area coincides with high poverty incidence and population density, and is in need of infrastructure and basic social services.

**Consultations**

A regional consultation was conducted in Accra, Ghana, in September 2019, with representatives from government, academia, donors, and civil society organizations from selected West African countries, including Nigeria, to solicit feedback on the modeling results.

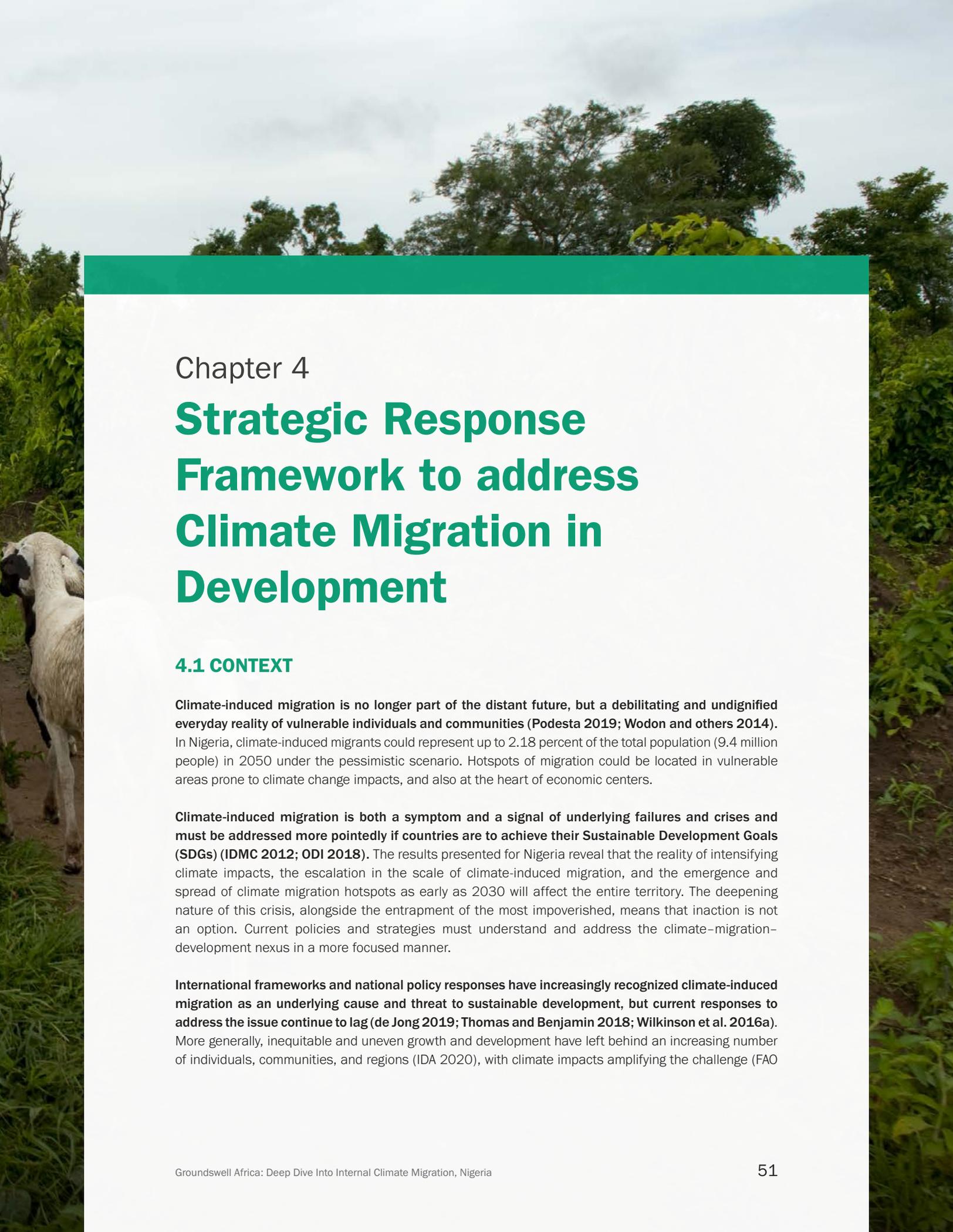
A second, virtual, consultation was conducted in March 2021, at a regional level, with a focus on the results of the deep dive analysis for Nigeria and the overall strategic response framework, including implications for policy and action (World Bank, unpublished). During the virtual consultation, participants underlined that migration is not new in the sub-region and that several drivers, in addition to climate change, motivate people to move from one place to another. There was wide agreement that land degradation was a critical driver of migration, in particular in arid and semi-arid areas, and participants drew attention to the escalating conflicts between pastoralists and farmers brought about by changing migration patterns. Participants also suggested that clarifications be provided with regard to hotspots in unexpected areas, for example in dry zones of the Sahel that have been identified as in-migration hotspots

by the model. Increasingly, seasonal “rural to urban” migration is turning into permanent migration as individuals grapple with worsening environmental conditions and diminished resilience capacity. In West Africa, there are strong inter-linkages between the loss of livelihoods (as a result of diminished livestock, crop productivity, and drought), unemployment, conflicts, political radicalism and migration.

**Feedback emphasized need for an integrated approach to tackling migration in the region by mainstreaming climate change factors in future migration policies remains critical.** Fragility and conflict are key emerging issues to consider, as they tend to exacerbate migration patterns in the region. Participants requested that the link between conflict and migration be better reflected in the model as these elements could also impact projections related to climate migration given the increasing level of instability in the region. Future population growth remains paramount to factor into any development planning process including migration policy design. Participants provided some examples of sound solutions adopted to manage migratory movements, including ensuring adequate water points along transhumance corridors for livestock, which helped reduce conflicts between herders and local communities, or providing training to farmers on soil fertility to slow agricultural productivity decline, a factor which has contributed to out-migration.



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## Chapter 4

# Strategic Response Framework to address Climate Migration in Development

### 4.1 CONTEXT

**Climate-induced migration is no longer part of the distant future, but a debilitating and undignified everyday reality of vulnerable individuals and communities (Podesta 2019; Wodon and others 2014).** In Nigeria, climate-induced migrants could represent up to 2.18 percent of the total population (9.4 million people) in 2050 under the pessimistic scenario. Hotspots of migration could be located in vulnerable areas prone to climate change impacts, and also at the heart of economic centers.

**Climate-induced migration is both a symptom and a signal of underlying failures and crises and must be addressed more pointedly if countries are to achieve their Sustainable Development Goals (SDGs) (IDMC 2012; ODI 2018).** The results presented for Nigeria reveal that the reality of intensifying climate impacts, the escalation in the scale of climate-induced migration, and the emergence and spread of climate migration hotspots as early as 2030 will affect the entire territory. The deepening nature of this crisis, alongside the entrapment of the most impoverished, means that inaction is not an option. Current policies and strategies must understand and address the climate–migration–development nexus in a more focused manner.

**International frameworks and national policy responses have increasingly recognized climate-induced migration as an underlying cause and threat to sustainable development, but current responses to address the issue continue to lag (de Jong 2019; Thomas and Benjamin 2018; Wilkinson et al. 2016a).** More generally, inequitable and uneven growth and development have left behind an increasing number of individuals, communities, and regions (IDA 2020), with climate impacts amplifying the challenge (FAO

et al. 2020; World Bank 2020c). Greenhouse gas (GHG) emissions continue to increase and compliance with the Paris Agreement is at risk (UNEP 2020; Watson et al. 2019). In the absence of transformative action at scale on climate and development, climate-vulnerable countries are projected to be dealing with increasing numbers of internal climate migrants by 2050 (Rigaud et al. 2018).

**Nigeria is a signatory to several international agreements related to migration and mobility.** Nigeria has signed or ratified a number of international conventions on migration policy, including the United Nations International Convention on the Protection of the Rights of All Migrant Workers and Members of Their Families, and several core ILO conventions. Nigeria is a member of the ECOWAS and participates in regional dialogues and fora on migration culminating in the adoption of several strategic frameworks such as the African Union Strategic Framework for a Policy on Migration (2004), the African Union Common Position on Migration and Development (2006), and, at the subregional level, the ECOWAS Common Approach on Migration (2008). Since 2000, Nigeria has facilitated, with ECOWAS support, the use of the International Transhumance Certificate (ITC), a sort of passport to facilitate cross-border transhumance for nomadic herders (Rigaud et al. 2018; Alex and Gemenne 2016). Finally, in 2012 Nigeria ratified the African Union Convention for the Protection and Assistance of Internally Displaced Persons in Africa (known as the Kampala Convention).

**The adoption of the AU Migration Policy Framework for Africa in Banjul in 2006 provides a comprehensive and integrated policy guideline for the preparation and adoption of national migration policies.** Nigeria formally adopted a National Policy on Migration and its implementation plan with support from the IOM and the European Union in 2015. The policy recognizes the growing linkage between climate change impacts and population distribution and mobility and therefore a cross-cutting theme for action. It identifies two specific objectives: (a) to ascertain migration–environmental and degradation–climate change inter-linkages and how they affect the movement of persons and development in the country; and (b) to strengthen capacities of national institutions involved in environmental management and climate change, cognizant of migration as both a cause and a consequence of environmental change. The 2011 National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN) recognizes that migration in many rural areas may increase as a consequence of the negative impacts of climate change and may lead to potential social conflicts (Nigeria Federal Ministry of Environment Special Climate Change Unit 2011).

**Migration as an adaptation strategy can be a pathway out of poverty** (Adger et al. 2003; Barnett and O'Neill 2012; Ellis 2003). Under certain circumstances, voluntary migration can be a desirable form of adaptation, not a reflection of failure to adapt (Black et al. 2011; McLeman and Smit 2006). However, migration must be addressed holistically and embedded in development policies and planning through inclusive and participatory approaches. Strengthening adaptive capacity and increasing readiness in the face of climate change can create an enabling environment for the positive effects of migration to manifest (Rigaud et al. 2018; Warner et al. 2009). Nigeria's 2011 NASPA-CCN establishes a clear link between climate events and migration (including internal migration) and makes recommendations in terms of reducing vulnerability via participatory planning of land use and housing, conducting research to better understand the nexus between migration, climate change and security, and strengthening rural settlements and livelihoods to limit out-migration. More recently, Nigeria's first Nationally Determined Contribution (NDC) submitted in 2017 as part of the UNFCCC provides priority actions to adapt key sectors such as agriculture, forests, energy, transport and communication, industry and commerce, and vulnerable groups.

**The urgency for transformative and far-sighted planning and action on climate migration cannot be postponed—with 2030 being a critical year.** The latest IPCC report finds that the global average temperature increase will likely exceed 1.5°C within the next two decades, and could potentially surpass 2°C by the end of the century if carbon-intensive human activities continue at the current rate (IPCC 2021). Climate impacts will continue to deepen existing vulnerabilities and lower capacities, leading to poverty, fragility, conflict, and violence. Already, the number of additional displacements attributed to disasters is on the rise—out of more than 40.5 million new displacements in 2020, 30.7 million were a result of floods, storms, and wildfires, with 4.3 million internal displacements occurring within Sub-Saharan Africa

(IDMC 2021). Nigeria is already facing serious environmental degradation, which is eroding the natural resource base, and the country is among the top 10 most vulnerable countries in the world when it comes to climate change (World Bank 2020c). Ex-post responses to crises will not suffice. It is imperative to have a step change—transformation at scale—to counter distress-driven climate migration as part of broader development action.

**There is a real opportunity to harness climate migration as a factor of growth, jobs, and economic transition within countries, which to date has remained untapped (Scheffran, Marmer, and Sow 2012; Rigaud and others 2018).** A unified approach to addressing climate migration must deliver on the core development needs—food, water, environment—and priorities to deliver on the countries SDGs and the Bank’s poverty reduction goals (World Bank 2020c). Climate migration will play out against a backdrop of other mega-trends of population growth, urbanization, and biodiversity loss as well as technological innovation, digital revolution, and broader economic transitions to low-carbon pathways (World Bank 2020d). The plausible climate migration scenarios presented in this report are not cast in stone but provide an opportunity—through proactive global and local/national action—to not just reduce the scale of climate migration, but to harness opportunities for growth and jobs as part of the transition to resilient and low-carbon economies in the pivotal 2020s decade. This chapter proposes a strategic response framework for mainstreaming climate migration into development policy and planning in Nigeria.

## 4.2 MACS FRAMEWORK

**Climate migration is a reality and a cross-cutting issue which has to be addressed through policy-informed actions that are farsighted in their approach and execution.** Unless concerted climate and development action is taken now, the scale of climate migration will ramp up by 2050, and hotspots of climate in- and out-migration will spread and intensify. These trends will likely accelerate beyond 2050 with worsening climate change.

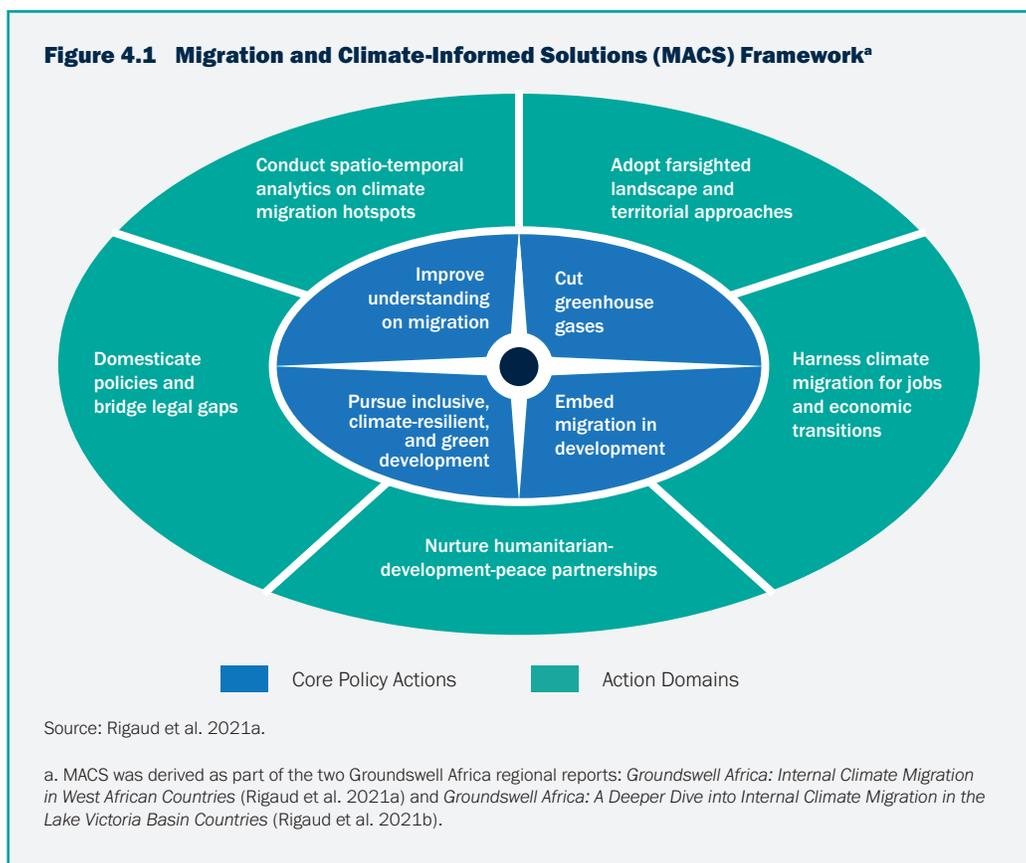
**The World Bank’s *Groundswell* report underscored the need for bold and transformational action to address climate-induced migration through four lines of policy action (Rigaud et al. 2018)**

- Cut greenhouse gases now.
- Pursue inclusive, climate-resilient, and green development.
- Embed climate migration in development planning.
- Invest in an improved understanding of migration.

**These policy directions must be buttressed with a core set of action domains to ensure durable and sustainable development outcomes with respect to distress-driven climate migration (Figure 4.1).**

**The Migration and Climate-Informed Solutions (MACS) framework (figure 4.1) allows us to make connections across time and space that have hitherto been missing and cope with future uncertainties and disruptions.** It seeks to ensure that vulnerable communities are prepared to confront current and future climate risks, and that the economy of the country is braced not just for the challenges, but also the opportunities of climate migration.

**MACS stems from the growing interest within the World Bank and the wider community to better understand the implications of climate induced migration and mainstream this phenomenon into development plans, programs and policies.** The *Groundswell* report (Rigaud et. al. 2018) introduced slow-onset climate impacts (water stress, crop failure, sea level rise) into a model of future population distribution—and established four core policy actions central to MACS framework: (i) cut greenhouse gases now; (ii) pursue inclusive and climate-resilient development policies; (iii) embed climate migration in development planning; and (iv) invest in an improved understanding.



The findings from *Groundswell Africa* (Rigaud et al. 2021a and 2021b) paved the way for domains of action to bolster the delivery of core policy directions set within MACS to reduce, avert, and minimize distress-driven internal climate migration. The modeling results were contextualized with a review of the current and historic mobility patterns and a regional stakeholder consultation. This analysis was further supplemented by the examination from the design features of 165 World Bank projects operating at the climate-migration-development nexus with commitments amounting to US\$197.5 billion between 2006-2019 (Rigaud et. a. 2021d).

The MACS framework is the outcome of the World Bank’s efforts through the *Groundswell* reports (Rigaud et al. 2018; Clement et al. 2021) and subsequent deeper dives via *Groundswell Africa* (Rigaud et al. 2021a and 2021b) to better understand the implications of climate-induced migration and mainstream this phenomenon into development plans, programs, and policies. It stems from the result of the abovementioned modeling exercise, contextualized against current and historical mobility patterns, peer reviewed literature, and multi-stakeholder consultations. A portfolio review of the design features of 165 World Bank projects operating at the climate-migration-development nexus further informs this framework (Rigaud et al. 2021c).

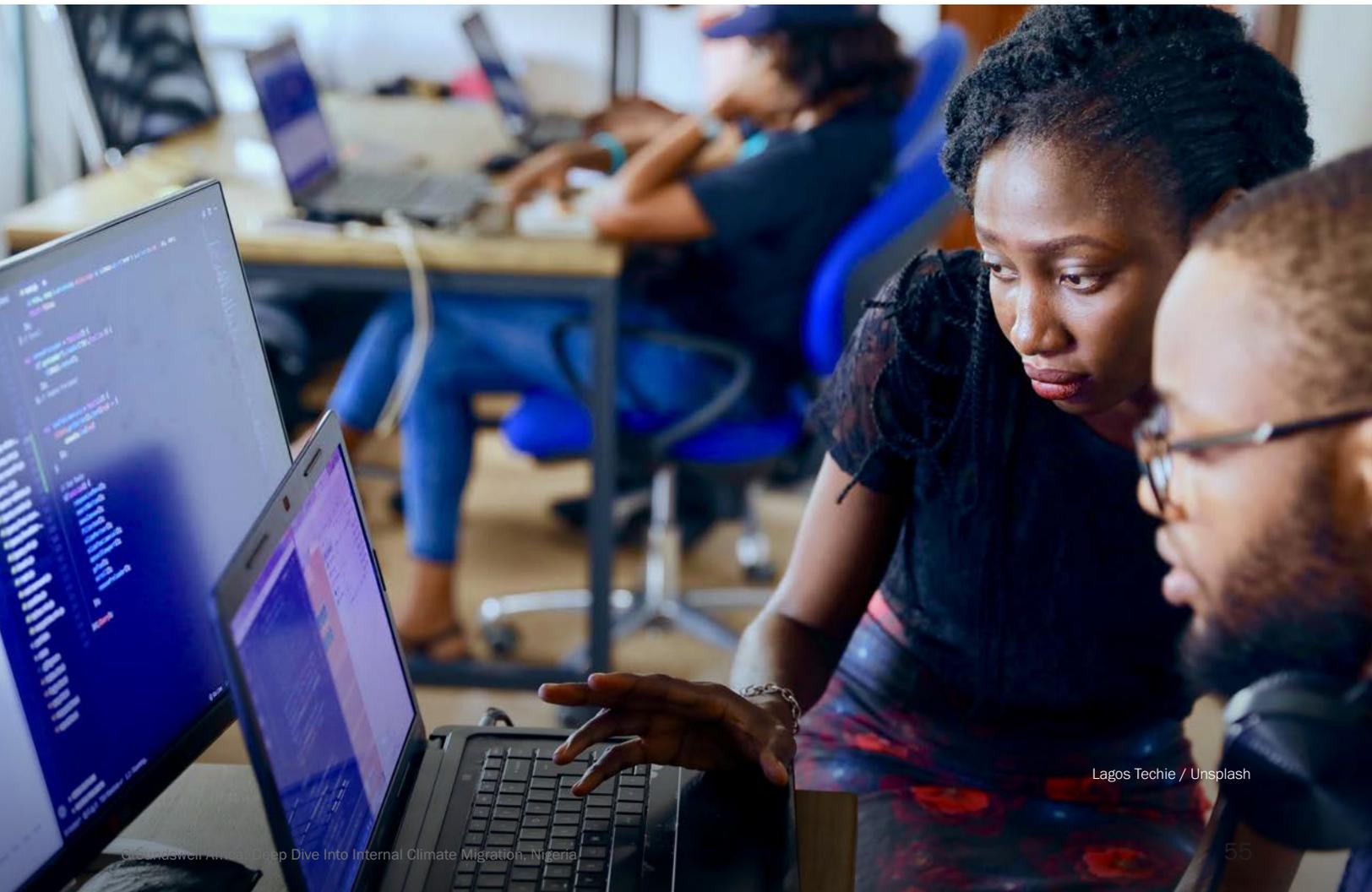
MACS is flexible and adaptive, based on the premise that climate migration is linked to broader development challenges across spatial scales. It can guide policymakers and practitioners by offering critical information and insights related to development and policy implications of climate-induced internal migration. This reflects the call for anticipatory approaches over larger time and spatial scales to avert and minimize the adverse consequences of climate-induced migration and harness opportunities brought forth by migration.

#### 4.2.1 Overarching Core Policy Directions

Action across the four major policy areas of the MACS framework (Figure 4.1) could help reduce the number of people forced to move in distress due to climate change.

##### 1. Cut greenhouse gases now to reduce climate pressure on people's livelihoods and the associated scale of climate migration

**Rapid reductions in global emissions can reduce the scale of climate migration and movements under distress.** Lower global emissions reduce climate pressure on ecosystems and livelihoods and broaden the opportunities for people to stay in place or move under better circumstances. In Nigeria, internal climate migrants as a percentage of population could drop from a mean of 1.93 under a pessimistic scenario to a mean of 0.3 under an optimistic scenario by 2050 (Table 3.1). Stringent global climate action would be needed to adhere to the UN's Paris Agreement and limit future temperature increases to less than 2°C by the end of this century, close to the more climate-friendly scenario in this report. According to UNEP (2020), the world is moving towards a temperature rise in excess of 3°C this century and this could increasingly foreclose some of the options for reducing climate-induced migration. Increased ambition in the next round of NDC submissions must have bold and comprehensive mitigation policies and include carbon pricing, urban and land use planning, and innovations in performance standards. Mitigation policies must be inclusive and pro-poor, guarding against potential blowback of mitigation measures. In Nigeria, our analysis indicates that low-carbon emissions growth and equitable development can lower the scale of future climate-induced human mobility by around 7.2 million people by 2050.



## 2. Pursue inclusive and climate-resilient development policies together with targeted investments to manage the reality of climate migration

**Climate migration demands anticipatory development policies that respond to the scale of the issue over the medium to long term.** If action is undertaken sooner rather than later, Nigeria will be in a more manageable position to address the projected increase in the number of climate migrants by 2050, which could represent close to 2 per cent of the total population. In some cases, an economic transition toward sectors that are less sensitive to climate change need to be part of the longer-term solution. These shifts can provide alternative job opportunities for climate migrants and growing populations and help strengthen the resilience of economies. Good management of demographic transitions and investment in human capital can also reduce climate vulnerability. Targeted interventions—such as facilitating informed migration decisions, making social protection portable and scalable, and tapping the potential of financial and social remittances—must be deployed in the short and medium term to support positive and sustainable outcomes. New interventions supported by the World Bank such as the Agro-Climatic Resilience in Semi-Arid Landscapes (ACReSAL) project, under preparation, focus on increasing the adoption of climate-resilient landscape management practices and enhancing livelihoods in targeted arid/semi-arid watersheds in Northern Nigeria. The project will tackle soil erosion, watershed management, and flood management to protect the natural resource base and thus support livelihoods in dry, semi-arid regions in selected northern states (World Bank 2020b).

## 3. Embed climate migration in development planning

**There is an urgent need for countries to integrate climate migration for all phases of migration across timescales into national development plans and policy.** Most regions have poorly prepared laws, policies, and strategies to deal with people moving from areas of increasing climate risk into areas that may already be heavily populated. Policy focus on the full migration life cycle i.e., *adapt in place*, *enable mobility*, and *after migration*, will ensure the presence of an adequate ecosystem to avert, minimize, and address climate-induced migration in response to current and future climate risks and impacts. Given the slow pace of lowering emissions globally, transformative and at-scale inclusive development becomes an even greater imperative to counter distress-driven climate migration.

**Adapt in place ensures help to communities to stay in place where local adaptation options are viable and sensible.** Components of successful local adaptation include investing in climate-smart infrastructure, diversifying income-generating activities, and building responsive financial protection systems for vulnerable groups, including women. Under the Nigeria Erosion and Watershed Management Project (NEWMAP), the country aims to reduce vulnerability to soil erosion in targeted sub-watersheds by restoring major, high-risk gully systems and reducing vulnerability to further land degradation in south-eastern and northern states. One of the expected benefits of the project is to avoid displacement of communities living in or next to vulnerable areas. The NEWMAP has introduced a holistic watershed management approach linking poverty alleviation with maintaining sustainable ecosystems and better disaster risk management, blending grey (physical) and green (vegetative) technologies (World Bank 2012).

**Enable mobility facilitates movement of people away from unavoidable climate risks when the limits of local adaptation and viability of ecosystems are reached.** Governments should facilitate safe, orderly, and dignified migration (or, as a last resort, planned relocation) toward areas of lower risk and higher opportunity by providing skills training, information, and legal support.

**In after migration, sending and receiving areas, and their people, are well connected and adequately prepared for the medium and longer-term.** Policy makers should develop and implement migration preparedness plans for the immediate and longer-term population growth from migration. In particular, secondary cities have an increasing role to play as growth poles that can support large, active domestic markets and focus areas for tertiary manufacturing, while also strengthening rural to urban linkages by providing access to markets. Increasingly plans should include viable livelihood opportunities, skills training, critical infrastructure and services, registration systems for migrants (to access services and labor markets), and the inclusion of migrants in planning and decision-making.

#### 4. Invest now to improve understanding of internal climate migration

**More investment is needed to better contextualize and understand climate migration, particularly at scales ranging from regional to local, where climate impacts may deviate from the broader trends identified in a global-scale analysis.** There are inherent uncertainties in the way climate impacts will play out in a given locale, and this will affect the magnitude and pattern of climate change-induced movements. Studies such as those conducted for this report are vital to provide insights on the scale of the issue. Over time, as more data become available on climate change and its likely impacts on water availability, crop productivity, and sea level rise, the existing scenarios and models would need to be updated. Increasing the modeling resolution and improving data inputs to produce more spatially detailed projections are among the possible future applications of the approach used in this report. Building country-level capacity to collect and monitor relevant data can increase understanding of the interactions among climate impacts, ecosystems, livelihoods, and mobility, and help countries tailor policy, planning, and investment decisions. Including climate-related and migration questions in national census and existing surveys are a cost-effective way to advance understanding of these issues.

**Decision-making techniques under deep uncertainty need to be further developed and applied for policymaking and development planning.** Evidence-based research, complemented by country-level modeling is vital. In support of this, new data sources—including from satellite imagery and mobile phones—combined with advances in climate information can be beneficial to improving the quality of information about internal migration. Under the WACA regional program and as mentioned in the new CPF for Nigeria, detailed analysis is underway to assess coastal challenges and potential areas of interventions in Nigeria (World Bank 2020b).

#### 4.2.2 Domains of Action to Drive Planning and Action at Scale

**The diversity of contexts where internal climate migration will play out calls for focused attention and cogency in response and can be guided by the five action domains of the MACS framework to reduce, avert, and minimize distress-driven internal climate migration** (Figure 4.1). Climate migration as a crosscutting issue has to be addressed through policy-informed action that is farsighted in its approach and execution. Mobilizing action for these domains in the Nigerian context is as presented below and summarized in Table 4.1.

##### 1. Conduct spatio-temporal analytics to understand the emergence of climate migration hotspots

**Climate-induced migration is not uniform within Nigeria—its impacts vary across space and time.** As a result, it poses distinct spatial challenges that necessitates spatially aware long-term planning that can avert, minimize, and reduce the negative impacts of climate migration. While the increase in climate migration is projected as a gradual trend over the next 30 years across all scenarios, the reality for Nigeria is that migration hotspots are projected to emerge as early as 2030. In addition, the scale of the climate in-migration in Nigeria will take place in pockets with already high levels of poverty, thus prompting the need for immediate action. Expanded and more granular modeling and analysis undertaken in this study, including a focus on water stress, crop productivity, net primary productivity, sea-level rise compounded by storm surge, floods, and conflict would benefit from local data, tailored assessments, and on-site interviews. These findings have important policy implications and require greater scrutiny and analysis. It is imperative to develop climate migration hotspot maps for the country and identify spatial climate risks and impacts to secure resilience.

**Early action, aided by state-of-the-art models on the current and future trends of mobility, is crucial for policymakers to drive proactive and informed action in this regard.** Investing in evidence-based research at the national level and mobilization of new data sources—including from satellite imagery and mobile phones—can help better contextualize and understand climate migration (particularly at local scales) where climate impacts may deviate from the broader regional or global trends. The results from this study demonstrate that climate migrants will move from less viable areas with lower

water availability and crop productivity and from areas affected by rising sea level and storm surges. These trends and the emergence of “hotspots” of climate migration will have major implications on conceiving effective responses. In Nigeria, climate out-migration will tend to correspond with areas of lower poverty incidence (Lagos, Ogun, Rivers, Ondo, Delta, Bayelsa, Rivers, Akwa), which could experience population dampening, while climate in-migration hotspots are projected for the north and north-east (Kano, Katsina, Sokoto) where poverty incidence is highest and population density is already high (Kano, Sokoto). These trends imply the need for differential strategies to address climate-induced migration and greater development efforts, investments, and focus to adequately prepare Nigeria’s states for the projected inflow of climate migrants. The suite of policy actions to embed resilience in hotspots should include investments and economic opportunities in green industry, environmental safeguards, institutional strengthening and coordination, and the creation of health, sanitation, and energy infrastructure.

## **2. Enable/embrace landscape and territorial approaches for far-sighted planning to avert, minimize and address climate-induced migration**

**Climate change impacts along with other socioeconomic trends could change the desirability of land and natural resources, alter the patterns of their use, and shift the comparative advantage of locations across the landscape** (Childress, Siegel, and Törhönen 2014). Ultimately, these changes have implications on migration patterns and necessitate deeper engagement with land use and their interactions with broader forces. Nigeria’s coast is particularly vulnerable to climate change and extreme events. Lagos hosts 10 percent of the population and is the country’s economic powerhouse, growing at 5.8 percent annually, yet it is among the top 10 vulnerable cities in the world. In spite of being increasingly congested, Lagos is a positive example of state reforms where officials have invested public expenditure in critical social programs such as education to manage the large inflow of in-migration from rural areas (for example, by building new schools and ensuring teachers’ welfare) (World Bank 2020c). Further, analysis of climate change impacts on landscape, terrestrial and marine ecosystems, and natural habitats in conjunction with community-focused planning is a step forward. Local Integrated Coastal Zone Management (ICZM) plans and analysis of adaptation options are good entry points for communities to address the delicate balance between the coastline and riverine estuaries and thereby potentially avoid the loss of land and livelihoods due to severe marine erosion.

**The deployment of a landscape approach within larger territorial approaches enables planning across spatial and time scales through a focus on the entire migration life cycle (before, during, and after).** It takes into account the underlying causes of distress-driven migration, and addresses both slow-onset and rapid-onset migration and their inter-linkages. It offers a pathway to site-specific planning for climate-induced migration, with an expanded and integrated view of land that can support local priorities and natural resource uses. Unlike sector-oriented planning, it allows deeper understanding of human-natural ecosystems and how they impact migration through land management, natural resource management, livelihoods, and ecosystem integrity. Local, national, and regional level planning is essential to avert conflicts and crises, which will be amplified by population increase. Site-based and locally driven practices to undertake forest management, conserve wildlife, develop water management plans and integrated community programs, and land use plans will enable communities to avert, minimize, and address climate-induced migration.

### 3. Address and harness climate-induced migration as an opportunity for jobs and economic transitions

**Migration affects the well-being of the migrant, the household, and the sending and receiving community (World Bank 2019c).** Incremental, low-regrets measures alone will not be sufficient to counter the magnitude of climate impacts (Kates, Travis, and Wilbanks 2012). Sequences of flexible incremental adaptation should be explored alongside more transformational adaptation, to secure resilience over longer timescales (Kates, Travis, and Wilbanks 2012; Pal et al. 2019). Sound management of demographic transitions and investment in human capital can reduce adverse impacts of climate migration. With more erratic rainfall patterns and a projected decrease in agricultural productivity, Boosting less climate-sensitive sectors of its economy to support a large inflow of young job seekers will be important. To tap the demographic dividend, demographic transitions need to be accompanied by policies to absorb larger working age populations into productive and climate-resilient labor markets, and to ensure that they have good access to health care, employment, and education.

**Good management of migration, driven by climate change over longer time scales, can produce positive momentum for such shifts (World Bank 2019c).** Climate-smart urban transitions also provide win-win opportunities to invest in the next generation of skills to foster green and resilient jobs, and secure cities as engines of growth. For instance, vibrant cities in Nigeria like Lagos will be impacted by sea level rise compounded by storm surges, and could see a population dampening due to climate out-migration. In such cases, early action to fortify coastal assets through green and grey infrastructure must be optimized through adapt-in-place options, while considering participatory planned relocation as part of longer-term solutions. Anticipatory planning through a focus on climate in-migration to secondary cities or peri-urban areas could lay their foundation as growth poles in place of sprawling slums steeped in poverty. Combining these opportunities with climate-smart urban transitions that also nurture and build skills, talent, and the workforce to harness the youth bulge through a focus on energy-efficient, green, and resilient urban infrastructure and services would present a win-win policy option. Remittance services facilitation, access to livelihoods and education, skills training, registration services to improve access to public goods, accessible transport systems, social protection, mitigating conflict, cash for work programs, and formalizing land tenure offer ways to make migration work for all (Merotto 2019).

### 4. Nurturing development-humanitarian-peace partnerships for end-to-end action at the national and local levels

**Migration sits at the nexus of the humanitarian–development–peace efforts, and thus needs to be tackled with national and local stakeholders.** While this report does not focus specifically on cross-border migration, the modeling identifies numerous migration hotspots in areas close to national borders. Climate change can be an inhibitor or a driver of cross-border migration, depending on a range of factors that propel individuals to decide to move. Countries must deploy holistic strategies to deal with the different facets and actors of mobility in the face of climate change. Cooperation and stepped-up action by development, humanitarian, security, and disaster communities across the mobility continuum could greatly assist countries in pursuing more holistic and durable solutions to climate-induced migration and displacement (World Bank 2019c) in support of peace, stability and security in the region. In the past, humanitarian efforts were followed by development efforts and these operated with different objectives, counterparts, instruments and logic (Guinote 2020). However, climate change is posing novel challenges and causing hitherto unknown dilemmas to undermine the humanitarian, development, and peace agenda. Unplanned migration and the absence of policies and strategies to integrate different communities can exacerbate the existing social tensions and fault lines into a downward spiral, leading to conflicts (Thoha 2020). In Nigeria, with water becoming increasingly scarce, farmers are expanding their fields into pastoral regions and transhumance corridors even as pastoralists leave their villages with their herds earlier in the year to deal with drought, thus leading to increased tensions between migrant herders and sedentary farmers.

Treating migration as a nexus of the humanitarian-development-peace frameworks implies overcoming structural barriers and internal divisions around sources of funding, coordination mechanisms, and project timelines (OCHA 2017). This approach can benefit from the comparative advantage of different actors to strengthen the local capacity (OCHA 2017). Ultimately, this approach is geared to reduce humanitarian need, risk, and vulnerability through a range of well-aligned short-, medium- and longer-term contributions by humanitarian and development actors (ibid). The linkages need to happen in a contiguuum or simultaneously to secure peace, address the humanitarian objectives to save lives and alleviate human suffering, as well as achieve the development priority to alleviate poverty.

## 5. Bridge the gap in legal mandates and frameworks on climate-induced migration to support well-conceived responses

There is an absence of a comprehensive and coherent legal architecture to address climate-induced mobility (Leighton 2010; Kuusipalo 2020). Adequate protections under international law are generally not afforded to those moving primarily due to environmental factors (Kuusipalo 2020). As the impacts of climate change intensify, there will be more migrants and displaced people not adequately covered by law.

A well-defined and implemented legal architecture brings clarity, protects affected individuals and communities, and reconciles international funding and local decision-making (Mayer 2011). It can pave the way for migrants to demand and seek assistance, ensure meaningful consultation about relocation, secure tenure at the new location, restore, if not improve, their livelihoods, and ensure disadvantaged and vulnerable individuals and communities receive special attention (Kuusipalo 2020).



Arne Hoel

**Table 4.1 Domains of Action to Drive Planning and Action: Rationale and Illustrations**

DOMAINS OF ACTION	RATIONALE	ILLUSTRATION
1. Conduct spatio-temporal analytics to understand the emergence of climate migration hotspots	<p>Climate-induced migration leads to emergence of climate in- and out-migration hotspots and poses distinct spatio-temporal challenges.</p> <p>Coinvesting in iterative scenario modeling, grounded in new data and development progress, will be crucial for decisions on support based on countries' own progress against which climate-induced migration will unfold. Such investments will be best placed to facilitate long-term planning and investments in adaptive capacity to secure climate resilience.</p>	In Nigeria, areas of high poverty incidence in the north could emerge as hotspots for climate in migration by 2030 (Sokoto, Kano).
2. Adopt landscape and territorial approaches for farsighted planning to avert, minimize, and address climate-induced migration	<p>Addressing underlying causes of distress-driven migration—both slow- and rapid-onset climate factors—through enhanced land management, natural resource management, livelihoods, and ecosystem integrity must be a priority.</p> <p>Placement within larger territorial approaches to enable planning across spatial and time scales through a focus on the full migration cycle (adapt-in-place; facilitate mobility; and support planned relocation) is an imperative for readiness and sustainable and durable outcomes.</p>	In Nigeria, the coastal urban states like Lagos are projected to see climate out-migration as early as 2030 and potentially experience a negative net migration balance of close to 1 million (pessimistic scenario) by 2050.
3. Address and harness climate-induced migration as an opportunity for jobs and economic transitions	<p>Effective management of climate-induced migration can drive growth, jobs, and transition.</p> <p>Driving economic transition to help countries leapfrog into climate resilience at scale, by harnessing climate migration to nurture jobs, skills, and economic growth through well-conceived economic, demographic, and urban transitions.</p>	With one of the largest youth populations in the world, expected to reach 84 million in 2050, Nigeria can manage this transition by investing in the education, skills, and training of its youth providing them with jobs and opportunities geared towards a fast-paced, highly-connected and greener global economy.
4. Nurturing development-humanitarian-peace partnerships for end-to-end action at the national and local levels	<p>Climate-induced migration can exacerbate the current social fault lines and contribute to or exacerbate conflict and potentially derail humanitarian and development agendas of poverty reduction.</p> <p>For an end-to-end approach that provides for human dignity in mobility we need to work collectively and in partnership—building on mandates and responsibilities—with country governments and local actors.</p>	In Nigeria, conflicts between pastoralists and farmers in the northern states of Borno, Yobe, and Adamawa in a context of terrorism and insecurity linked to Boko Haram, call for a new look at farmer-herder conflicts and the integration of humanitarian-development-peace efforts.
5. Bridge the gap in legal mandates and frameworks on climate-induced migration to support well-conceived responses	<p>Legal architecture brings clarity, protects affected individuals and communities, and reconciles international funding and local decision-making ().</p> <p>There is an opportunity to build on the legal architecture to address climate-induced mobility to drive operations and response at scale.</p>	Addressing climate migration will require sound legal mandates and frameworks including the implementation of Nigeria's policy on migration at a national level and the operationalization and domestication of the ECOWAS protocol at a sub-regional level.

## 4.3 CALL TO ACTION

**Nigeria's Economic and Recovery Growth Plan (2017–2020) and the second ERGP's Priority Action Plan (PAP 2) for 2019–2023 provide key entry points for action.** The ERGP focuses on five strategic interventions as follows: (i) stabilize the macroeconomic environment; (ii) drive industrialization focusing on SMEs; (iii) achieve agriculture and food security; (iv) improve transportation infrastructure and (v) ensure energy sufficiency in power and petroleum products. As the country takes stock of the first ERGP's PAP implementation and prepares the next package of interventions, Nigeria should be encouraged to address emerging issues like climate-induced migration as a cross-sectoral development challenge.

**Key actions of the ERGP such as creating jobs for youth skilled in ICT hardware, providing incentives to support industrial hubs and SEZs, or boosting agricultural crop productivity and other sub-sectors (livestock, fisheries, etc.) remain relevant.** Other country-led documents support a proactive approach to climate change and its impacts on communities such as the National Adaptation Strategy and Plan of Action on Climate Change for Nigeria (NASPA-CCN) developed in November 2011, the National Migration Policy of 2015, and the Nationally Determined Contribution of 2017.

**The World Bank's Systematic Country Diagnostic (SCD) and Country Partnership Framework (CPF) aim to support Nigeria's ambition to promote sustainable growth.** The SCD prepared for Nigeria in June 2019 clearly emphasizes environmental degradation and climate change as key constraints to the country's sustainability and major obstacles to poverty reduction. The document estimates that about 90 percent of the total land area is affected by some form of soil erosion and growing water shortages threatening peace and stability, in particular in the northeast of the country. The country is particularly vulnerable to droughts, floods, landslides, gully erosion, and windstorms and the risks of climate are increasing (rising average temperature especially in the north, variable rainfall patterns, rising sea levels, and more frequent extreme weather events). Embedding climate migration in national and local planning processes will directly support pillar 4 of Nigeria's CPF which aims to improve natural resources management, protect the most vulnerable segments of the population, and improve access to basic social services.

**The new CPF for Nigeria approved in 2020 and covering the period FY21–FY25 focuses on 4 pillars including: (i) strengthening the foundations of the public sector; (ii) investing in human capital; (iii) promoting jobs and economic transformation and diversification; and (iv) enhancing resilience.** Enhancing climate resilience is one of the 10 CPF's core objectives with a special emphasis on modernizing agriculture. The CPF underlines the impact of extreme and more frequent weather effects such as floods and heat stress, especially in the northern parts of the country, on declining per-capita food production and consequently rising under-nutrition. The World Bank partnership document also links natural resource degradation, erosion, flooding, and pollution in extreme weather events, which in turn can amplify poverty and conflict.

**The World Bank Group efforts to address the adverse impacts of climate change on communities in Nigeria consist of a diversified package of operations focusing on climate-smart agriculture and on fragility and conflict mitigation, in particular in the north of the country.** Building on the successful NEWMAP operation in erosion and watershed management, the World Bank will invest in a major new project to support agro-climatic resilience in semi-arid lands. The ACRoSAL project under preparation will focus on increasing the adoption of climate-resilient landscape management practices (national and communal) and enhancement of livelihoods in targeted arid and semi-arid watersheds in Northern Nigeria. Although a wetter climate is projected in the northern parts of Nigeria, these states are also likely to become in-migration hotspots, thus requiring special attention.

**Working with Nigerian institutions to increase the productivity of the agriculture sector, together with the adoption of climate-resilient natural resources management practices, will mitigate the impact of agricultural labor shortage as a result of climate-induced rural-to-urban migration.** Supporting the agricultural sector by boosting the productivity of crops and other subsectors, improving access to markets, and promoting irrigable land and river basin infrastructure are key steps adopted by Nigeria to increase production and food security. Combining this with participatory and community-driven approaches to develop concerted natural resource management plans will bring added value to adaptation efforts.

**Our study shows that although projected at 2 percent of total population (averaging approximately 8.3 million people) under a pessimistic scenario, climate-induced migration is ramping up in Nigeria and is becoming evident as early as 2030.** Hotspots of in and out-migration are also emerging and do not fit traditional spatial patterns of migration. In-migration hotspots will occur in regions with high poverty levels and therefore with low preparedness and absorptive capacity. Therefore, supporting additional analytics and state of the art models and observation systems should improve the country's understanding of the emergence of climate migration hotspots.

**Considering the full migration cycle (before, during, and after moving) will assist urban planners in the preparation of a resilient land use mapping process and strengthen the role of regional/local authorities as part of a transition towards decentralization.** To do so, supporting the use of information technology innovations such as maps, mobile phones, and satellite data can help identify gaps in investments and services, in particular for pastoral mobility in times of crisis. Management information systems and databases can also assist in tracking beneficiaries and potential social services.

**Adopting a security and fragility lens to address migration challenges in Nigeria is conducive to reducing potential conflicts and thus better managing climate-induced mobility, given the strong inter-linkages between climate, migration, and fragility in the country.** The World Bank will support Nigeria's efforts to enhance service delivery and livelihood opportunities in the northeast and other regions affected by farmer-herder conflicts. Specific support includes investment lending for critical service infrastructure and livelihood opportunities through the Multi-sectoral Crisis Response Project in the Lake Chad Region and the future Livestock Productivity and Resilience Support Project. Sharing information across states such as early warning systems, facilitating movement along migration corridors, supporting market linkages, conducting livestock disease surveillance, and vaccination campaigns for pastoralists' livestock are sound potential actions. Training local institutions about conflict resolution related to land rights and land access between farmers and herders/pastoralists can also be transformative.

**Tackling the youth bulge in Nigeria and anticipating the mobility of young adults in search of new horizons will ensure that climate-induced migration is addressed and harnessed as an opportunity for jobs and economic transitions.** Migration should be considered as an opportunity, in particular for the youth moving to urban areas, in line with the domain of action on harnessing climate migration for jobs and smart economic transitions. This approach would support Nigeria's efforts to create jobs for the youth with adequate training and skills strengthening in promising sectors such as ICTs.

**Growth poles can be an important determinant for driving internal migrants and will require human capital investment alongside structural transformation.** Migration can be a positive driver of change, pressing cities to transition more quickly to technological innovations and develop employment strategies. This approach would support Nigeria's overall strategy in the ERGP to develop special economic zones (SEZ) and industrial or multi-services hubs with high potential for employment. Boosting secondary cities in Nigeria and enhancing greater linkages between rural and urban spaces through better physical and virtual connectivity will provide opportunities for migrants and contribute to reducing spatial/territorial imbalances.

**Finally, specific attention should be devoted to coastal areas by policy-makers.** Investing in coastal adaptation measures will limit pressure on urban assets and infrastructure along the coastal fringe, in particular if urban-urban migration becomes more prevalent as a result of rising sea level, compared to traditional rural-urban mobility in Nigeria.



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## Chapter 5

# Conclusion

**With a population that is expected to surpass the United States as the world's third most populous country by 2050, Nigeria has an established history of mobility driven by economic opportunities, trade, and nomadic pastoralism.** Its population has had to remain mobile due to slow- and rapid-onset natural events such as recurrent floods and coastal erosion. Looking ahead, with a population anticipated to double by 2050, Nigeria will be confronted by a changing climate including rising temperatures, erratic rainfall, increasingly intense rainfall events, flooding, and coastal erosion as a result of storm surges and sea level rise. Communities will remain particularly vulnerable to climate change given the high dependence of the economy on rain-fed agriculture, in particular for small-size farms, fisheries, and livestock production. Among those communities, the young will represent the segment of the population, which will require the most attention as they rapidly join the job market looking for new employment opportunities.

**Our analysis is showing that historical trends of migration in Nigeria are changing in the face of climate change.** Climate-induced migration will ramp up with intensifying climate impacts. Migration will be amplified and compounded, with patterns altered in the context of a changing climate. By 2050, climate-induced migrants are projected at 2 percent of total population. This represents an average of 8.3 million people under a pessimistic scenario, owing in great part to Nigeria's sizable population. This is the highest projected figure for West Africa coastal countries.

**Further, hotspots of in-migration are emerging in regions with low preparedness and absorptive capacity levels.** If these challenges remain unaddressed, Nigeria runs the risk of forsaking hard-won development gains and advances toward poverty reduction. Climate-induced migration is not inevitable and can be significantly reduced if low-carbon pathways with better development outcomes across the country are adopted. Low-carbon emissions growth and equitable development can lower the scale of future climate-induced human mobility by 7.2 million by 2050 in Nigeria, thus potentially offsetting the highest number of projected climate migrants.

**There is a call for urgent action as the window of opportunity narrows.** Without immediate action, Nigeria may see an early emergence of climate-driven migration hotspots in several parts of the country. Collective and global efforts and actions to meet the Paris target can make this process orderly, efficient, dignified and beneficial for all Nigerians. Migration can translate into an effective adaptation strategy that can also be harnessed for jobs, equity, and economic transitions, with conscious policy choices. This suggests a need for Nigeria to rapidly pursue highly resilient policies and economic transitions and shift towards less climate-sensitive sectors at scale.

**The core policy directions, domains of actions, and policy recommendations presented in this study offer a strategic response framework to comprehend and address this challenge, based on rigorous and state of the art evidence.** The MACS framework provides a platform to mainstream climate migration into planning and policy in support of climate-resilient and sustainable development outcomes (Figure 4.1). It allows us to make connections across time and space that have hitherto been missing. The convergence of COVID-19, climate change, and conflicts provide a strong rationale for a bold, transformative, and integrated line of farsighted action. This will ultimately ensure that vulnerable communities in Nigeria are well prepared to confront current and future disruptions.

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## Appendix A

# ISIMIP Projections to 2050–2100

**This appendix presents the projections for the water, crop, and ecosystem models out to 2050–2100 for the West Africa region.**<sup>31</sup> Positive index values are capped at 2, which represents a tripling of the baseline value (whether it be water availability, crop production, or ecosystem productivity).

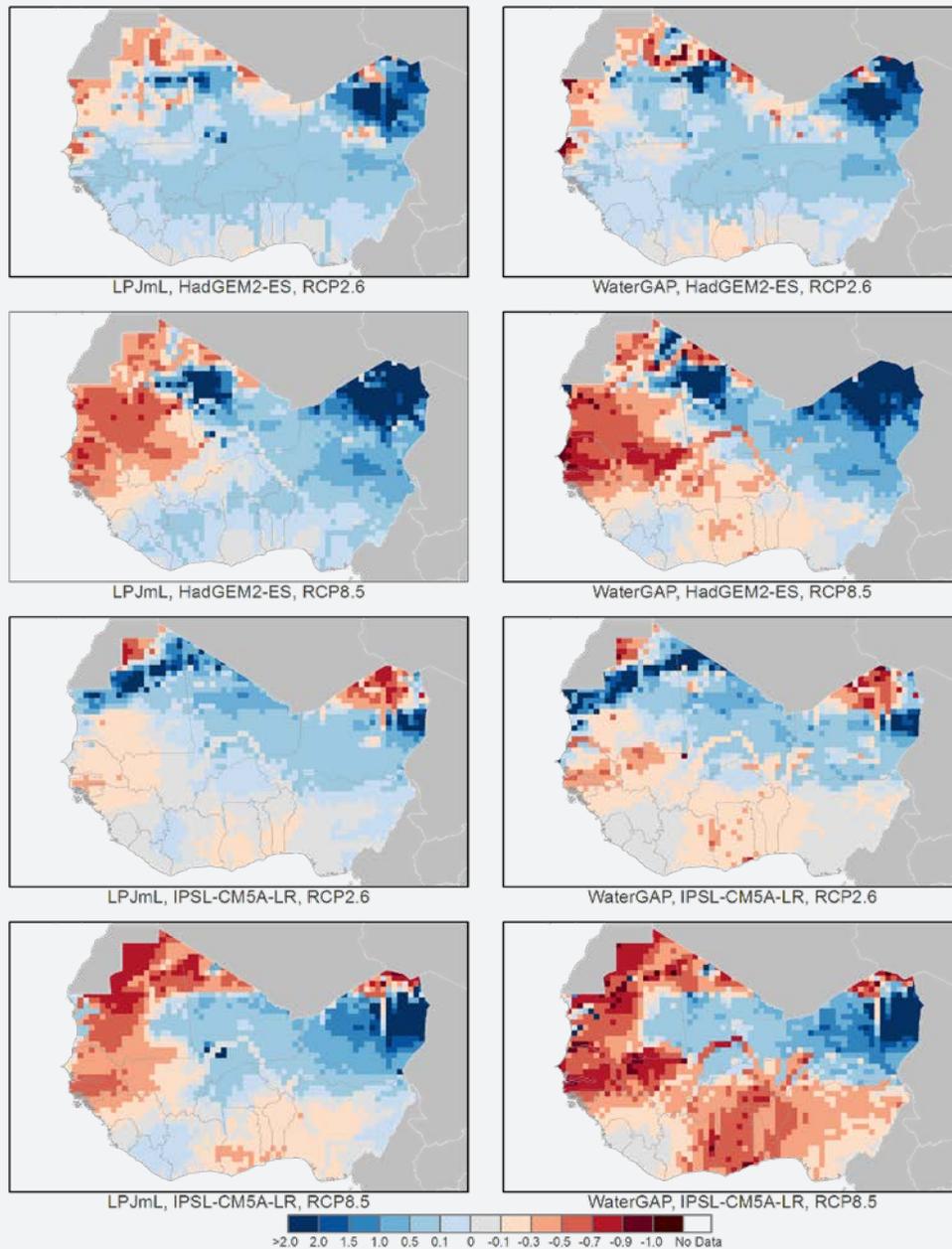
**Figure A.1 shows that the 2050-2100 water availability projections are consistent with its early trajectory.** Water availability will continue to decrease in the Western Sahel (Senegal into western Mali) and increase in the eastern Sahel (Burkina Faso and Niger). These trends will accelerate between 2050-2100, particularly in western Sahel and in the south under the IPSL-CM5A-LR global climate model and the Representative Concentration Pathway 8.5 (RCP8.5).

**Figure A.2 shows that crop production will follow its early patterns with decreases across much of the region (except Sierra Leone, Liberia, and the northern Sahel) and some patchwork of mostly increases with some decreasing crop production under the GEPIC model.** The 2050-2100 projections follow the same patterns with accentuated impacts, especially under RCP8.5.

**NPP models out to the end of the century show similar patterns of increases in plant biomass in the northern Sahel and into the Sahara.** These projections are against a very low baseline productivity, and should be interpreted in this light.

31. The projections used an index in which the historical baseline value is subtracted from the projected value and then divided by the historical baseline value. For more details on this index the overall methodology, please refer to the World Bank's report "Groundswell Africa: Internal Climate Migration in West African Countries" (Rigaud et al. 2021a)

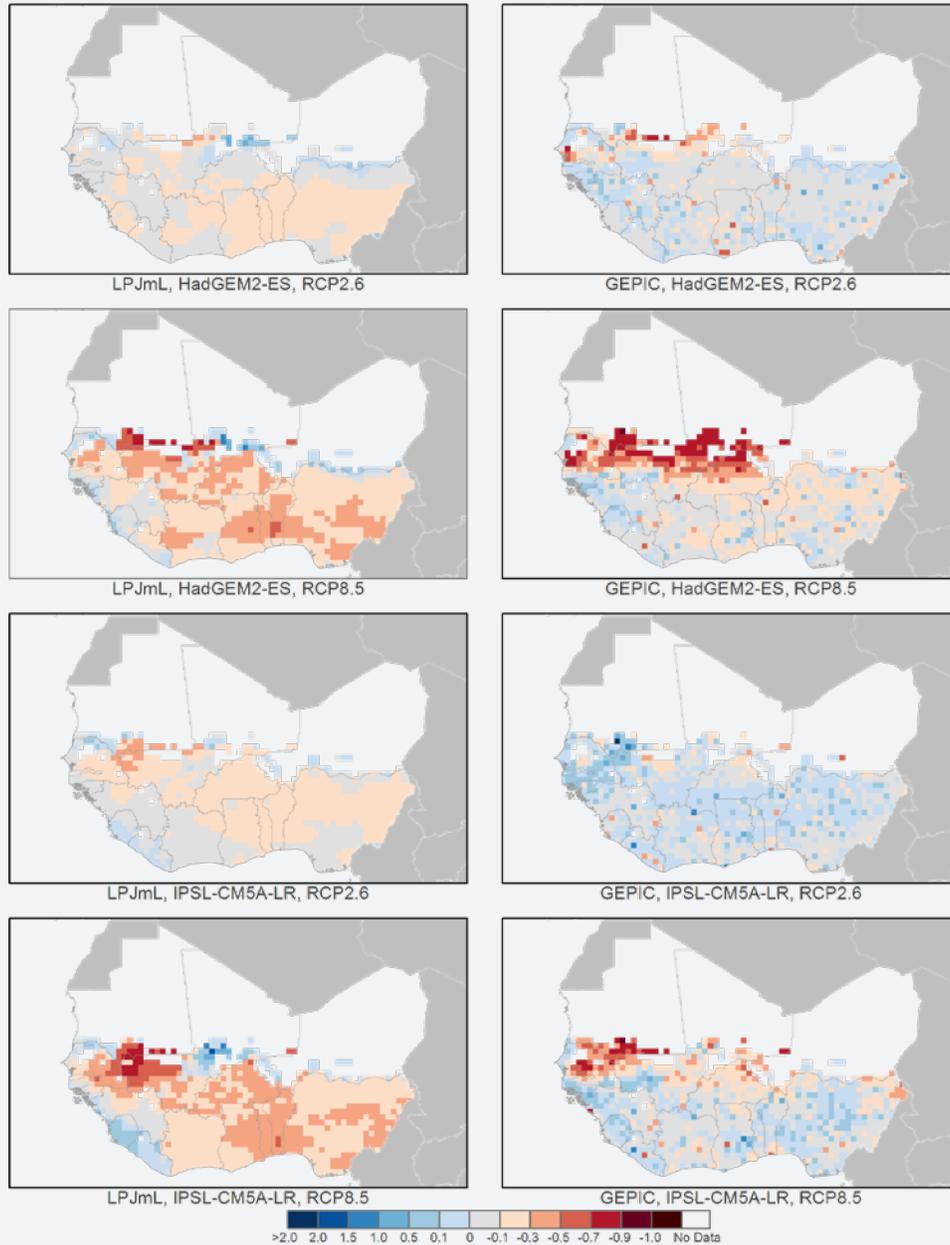
**Figure A.1 ISIMIP Average Index Values against 1970–2010 Baseline for Water Availability, West Africa, 2050–2100**



Source: Rigaud et al. 2021a

Note: Data compiled from LPJmL/water (panel a) and WaterGAP (panel b), forced with the HadGEM2-ES climate model (top four maps) and IPSL-CM5A (bottom four maps) under RCP2.6 and RCP8.5. Blue areas indicate wetting relative to the historical baseline, and grey and tan areas indicate drying.

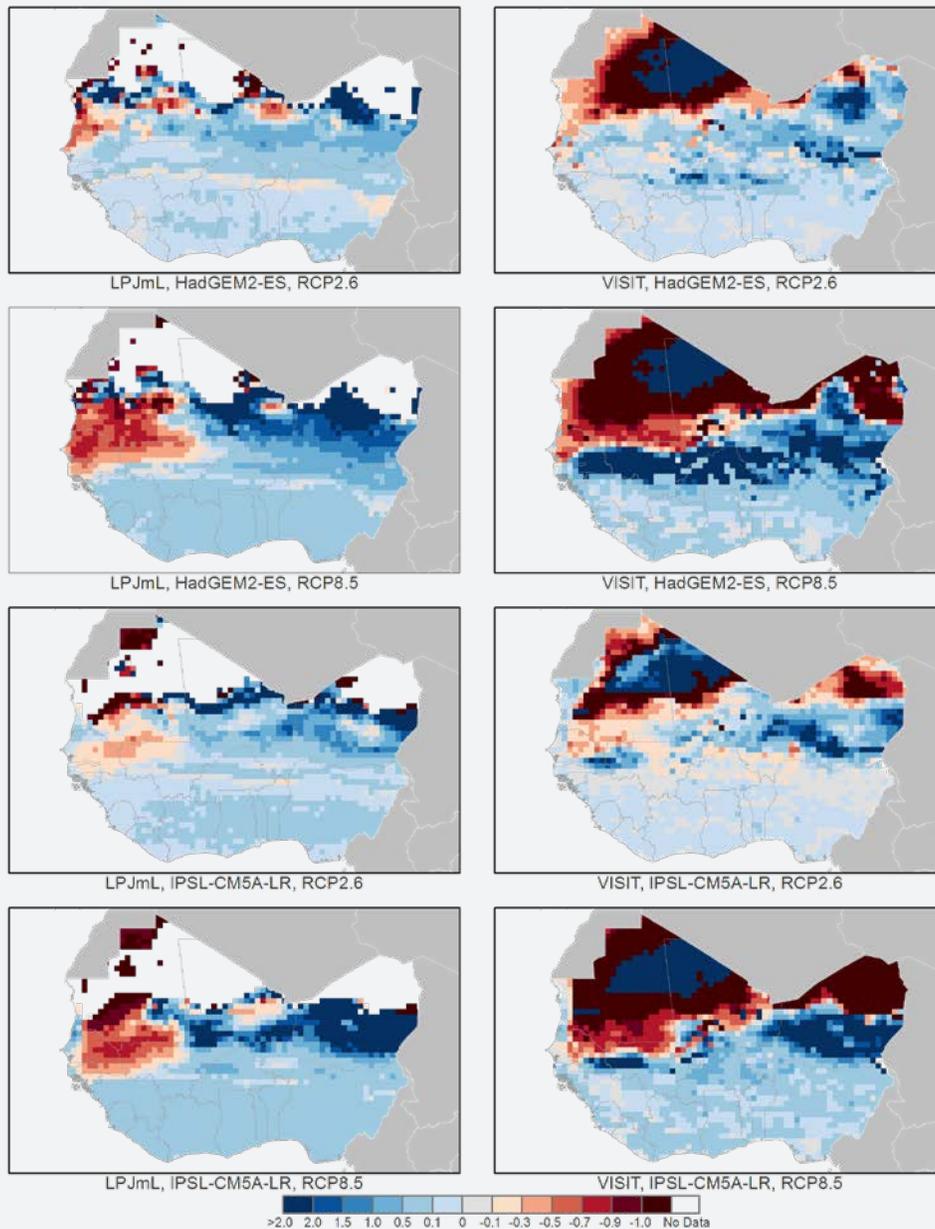
**Figure A.2 ISIMIP Average Index Values against 1970–2010 Baseline for Crop Production, West Africa, 2050–2100**



Source: Rigaud et al. 2021a

Note: Data compiled from LPJmL/crop (panel a) and GEPIC (panel b), forced with the HadGEM2-ES climate model (top four maps) and IPSL-CM5A (bottom four maps) under RCP2.6 and RCP8.5. Blue areas indicate wetting relative to the historical baseline, and tan to red areas indicate drying. White areas do not grow the four major crops.

**Figure A.3 ISIMIP Average Index Values against 1970–2010 Baseline for Ecosystem NPP, West Africa, 2050–2100**



Source: Rigaud et al. 2021a

Note: Data compiled from LPJmL (panel a) and VISIT (panel b), forced with the HadGEM2-ES climate model (top four maps) and IPSL-CM5A (bottom four maps) under RCP2.6 and RCP8.5. Blue areas indicate higher NPP relative to the historical baseline, and tan to red areas indicate lower NPP. NPP = net primary productivity.

