INTEGRATING CLIMATE ADAPTATION AND MIGRATION INTO LAND USE PLANNING FOR SUSTAINABLE DEVELOPMENT IN NORTH EAST NIGERIA

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EXECUTIVE SUMMARY

The study assessed land use changes in Northeast Nigeria using climate data, remote sensing, migration figures, and questionnaires. Results show declining rainfall, warming temperatures, and increasing urban expansion. Migration drivers include insecurity, employment, and education. The study urges integration of migration and climate policies, enhanced services for IDPs, promotion of climate-resilient farming, and investment in education, healthcare, and peaceful coexistence to strengthen regional resilience and sustainable development efforts.

INTRODUCTION

Driven by climate change and migration, global land use transformations have serious consequences. Northeastern Nigeria highlights these effects with rising displacement and environmental degradation (IOM, 2023; Adamu and Lawal, 2024; Ishaku et al., 2024). This research examines these interlinkages to guide sustainable land governance and resilience strategies for at-risk populations in similar vulnerable contexts.

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RESEARCH APPROACH

The study used NASA POWER climate data (1981 2021), Landsat imagery (1991 2021), and surveys from 1,155 respondents. Analyses included Mann-Kendall, Sen's slope, IDW, and Spearman's correlation. Tools like R, Python, GEE, ArcGIS, TerrSet, and Kobo Toolbox supported the examination of climate, migration, and land use and cover transformations of Adamawa, Borno and Gombe States.

KEY RESEARCH FINDINGS

1. Climate trends in the study area show decreasing rainfall and rising maximum temperatures, indicating warming. Minimum temperatures also declined slightly, reflecting shifting climatic conditions and potential stress on ecosystems and livelihoods (Figures 1,2 and 3. a. 1981 - 1990, b. 1991 -2000, c. 2001 -2010 d. 2011 -2021).

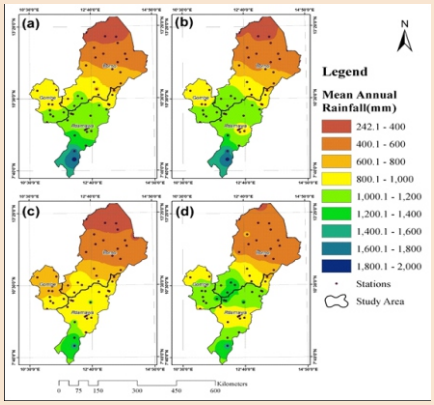

Figure 1: Rainfall Trend

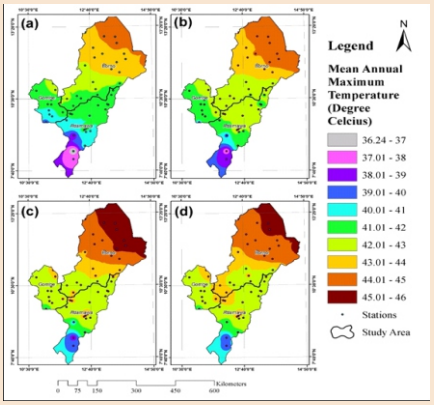

Figure 2: Tmax Trend

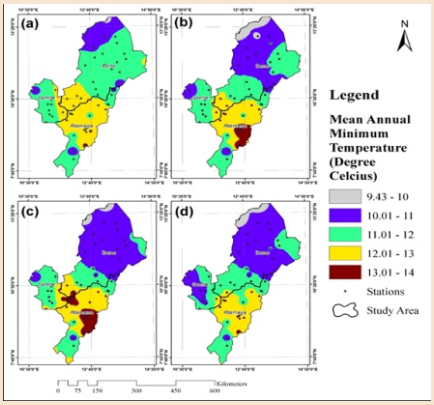

Figure 3: Tmin Trend

2. Seasonal trends reveal that rainfall and nighttime temperatures rise during the wet season, while extreme daytime heat occurs in the dry season key insights for climate-responsive planning and adaptation (Figures 4,5 and 6).

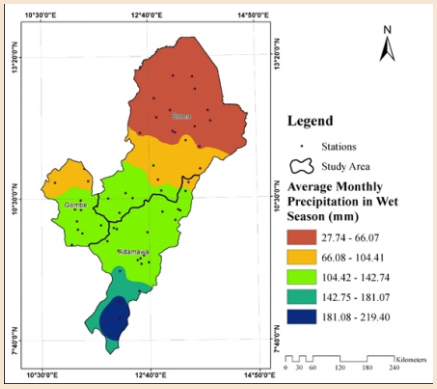

Figure 4: Rainfall Wet Season

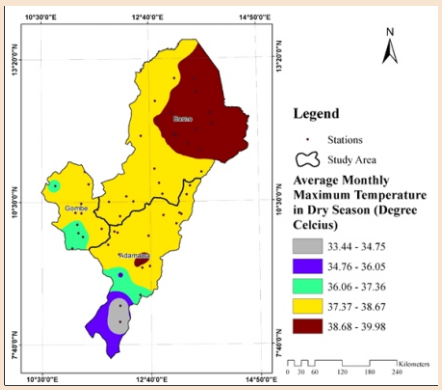

Figure 5: Tmax Dry season

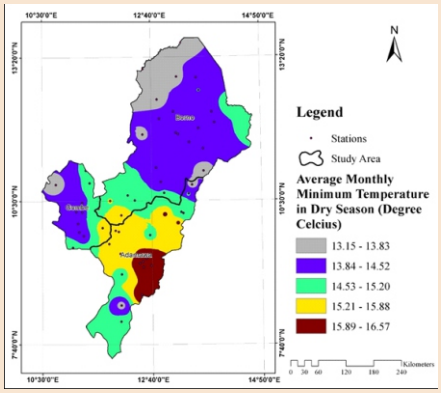

Figure 6: Tmin Dry Season

3. Employment prospects top the list of migration drivers, followed by the pursuit of education and concerns over securityhighlighting the need for socio-economic and stability-

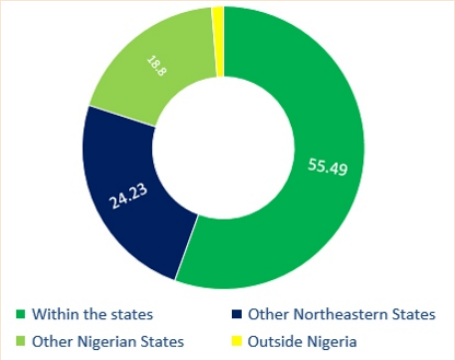

Figure 7: Migrant's origin

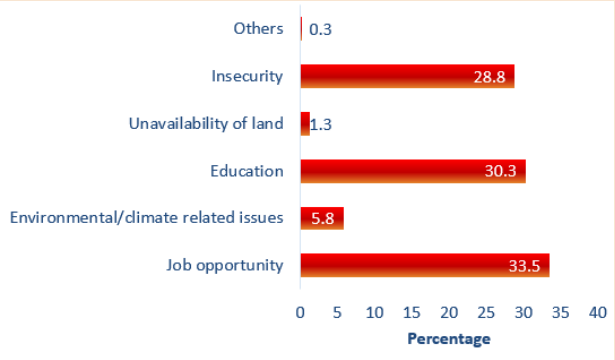

Figure 8: Reasons for Migration

4. A clear rural-to-urban migration trend toward state capitals was observed, highlighting urban centers as primary hubs for displaced and mobile populations.

5. Urban areas have progressively expanded, particularly in state capitals, leading to substantial loss of vegetation, bare land, and water bodiesunderscoring the need for sustainable land management (Table 1 and Figure 9).

Table 1: Land Use and Land Cover Transformation over the Years

class	1991		2001		2011		2021		2040
	Area(km²)	%	Area(km²)	%	Area(km²)	%	Area(km²)	%	Area(km²)
Bare/Sparse Vegetation	4465.30	3.50	170.07	0.13	684.78	0.54	613.67	0.48	192.24
Built up	462.84	0.36	942.98	0.74	1410.59	1.11	1725.67	1.35	3385.27
Cultivated Land	25201.55	19.78	71962.92	56.48	52414.98	41.14	39172.34	30.75	65142.27
Forest	20192.31	15.85	23112.49	18.14	8465.32	6.64	6262.21	4.92	32409.36
Grassland/Shrubs	70220.48	55.12	25974.63	20.39	59510.58	46.71	74995.27	58.86	21579.87
Water Bodies	6862.44	5.39	5241.82	4.11	4918.66	3.86	4635.74	3.64	4695.91
Total	127404.92	100.00	127404.92	100.00	127404.92	100.00	127404.92	100.00	127404.92

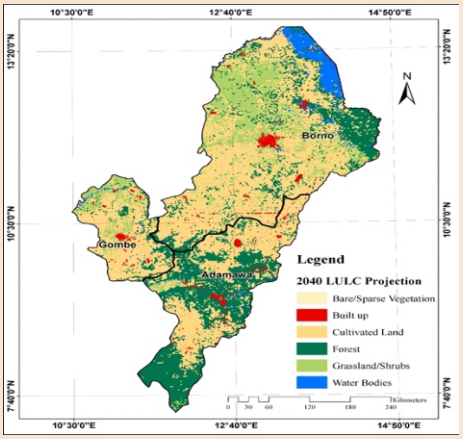

Figure 9: 2040 Land use and land cover projection

6. Significant spatial variations in the interplay between climate, migration, and land use changes underscore the need for tailored, location-specific adaptation and planning strategies (10, 11, 12 and 13).

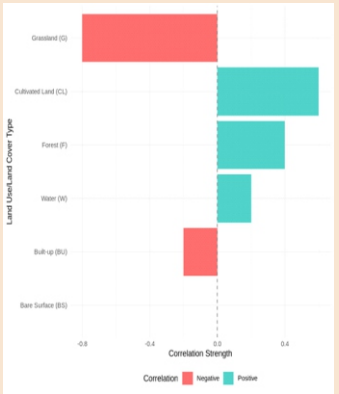

Figure 10: Correlation between Net migration and LULC types

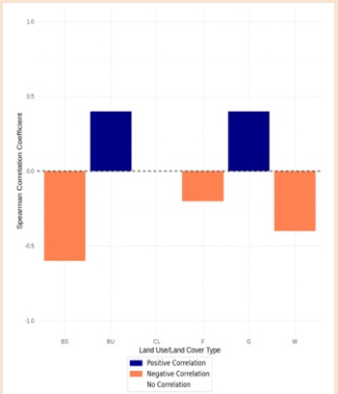

Figure 11: Correlation between Rainfall and LULC types

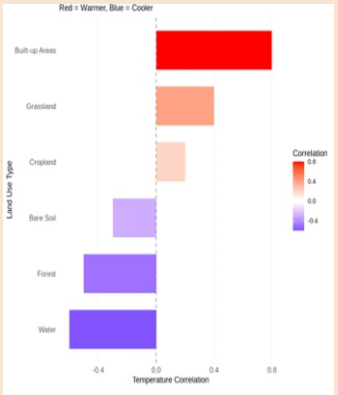

Figure 12: Correlation between Tmax and LULC types

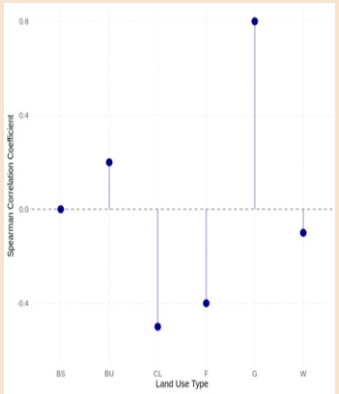

Figure 13: Correlation between Tmin and LULC types

IMPLICATION OF FINDINGS

Climate stress is mounting, with less rainfall and rising temperatures impacting agriculture. Urban migration intensifies pressure on infrastructure, while land cover changes threaten ecosystems. Addressing these challenges requires cohesive policies that integrate climate adaptation, urban planning, and sustainable land management. The implications underscore the need for a multifaceted approach to foster resilience against climate change and migration, supporting sustainable development in Northeastern Nigeria.

POLICY RECOMMENDATION

Develop and implement integrated policies that align climate adaptation strategies with urban development and land use planning. Prioritize sustainable agricultural practices, resilient infrastructure in urban areas, and ecosystem restoration to address the compounded effects of climate stress, migration, and land degradation.

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