

POLICY BRIEF

BALANCING URBAN DEVELOPMENT AND CLIMATE ADAPTATION IN CITIES: POLICY ACTIONS FOR A RESILIENT FUTURE

Kadiza DOULAY SEYDOU, Oluwole MORENIKEJI, Abdoulaye DIOUF, Ralf LÖEWNER, Appollonia Aimiosino OKHIMAMHE
Correspondence: kadidjadoulaye@st.futminna.edu.ng; Tel.: +22796355451

EXECUTIVE SUMMARY

In Tahoua and Zinder, unplanned urban growth and rising climate stress demand urgent policy intervention. This study proposes three priority actions: enforce climate-resilient infrastructure, regulate land use, and restore ecosystems. These policies aim to mitigate environmental degradation and support sustainable urban futures under growing climate challenges.

INTRODUCTION

Urbanisation in Niger, driven by migration and economic shifts, is intensifying environmental stress, including LULC changes and Urban Heat Island effects (Seydou et al., 2024). Despite this, policy remains infrastructure-focused, neglecting climate resilience. This brief highlights the urgency for integrated planning strategies that address rising temperatures and sustainability in vulnerable cities like Tahoua and Zinder.

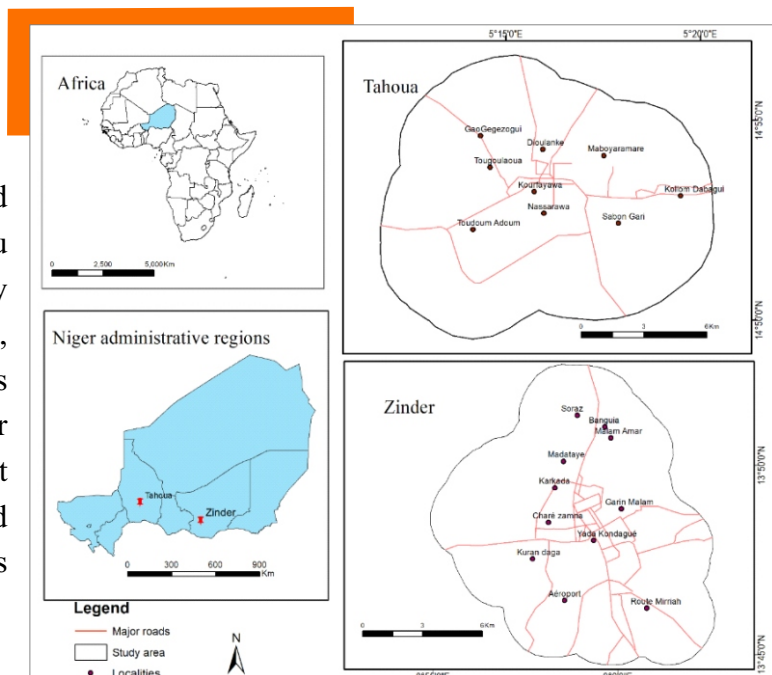


Figure 1. Location of the Study Area

RESEARCH APPROACH

Employing geospatial, biophysical, and socioeconomic approaches, this study assesses urban growth and its impact on LULC and LST in Tahoua and Zinder, Niger republic from 1988 to 2022. It applies machine learning for LULC analysis, urban growth models for direction analysis and IPCC Fourth Assessment Report (AR4) framework to assess heat vulnerability at the neighbourhood level in the two cities. Land Use Change Evaluation (MOLUSCE) modules simulate future trends of LULC and Neural Network for LST simulation, with validation showing over 75% accuracy.

KEY RESEARCH FINDINGS

1. Land use and land cover change

Tahoua (Figure 2) and Zinder (Figure 3) saw dramatic urban expansion between 1988 and 2022, driven by demographic and economic factors. This growth led to agricultural and vegetation loss, raising concerns for food security. With urban sprawl dominating, strategic policies are needed to incentivise infill development, limit peripheral expansion, and promote land use practices that support urban resilience and ecological balance.

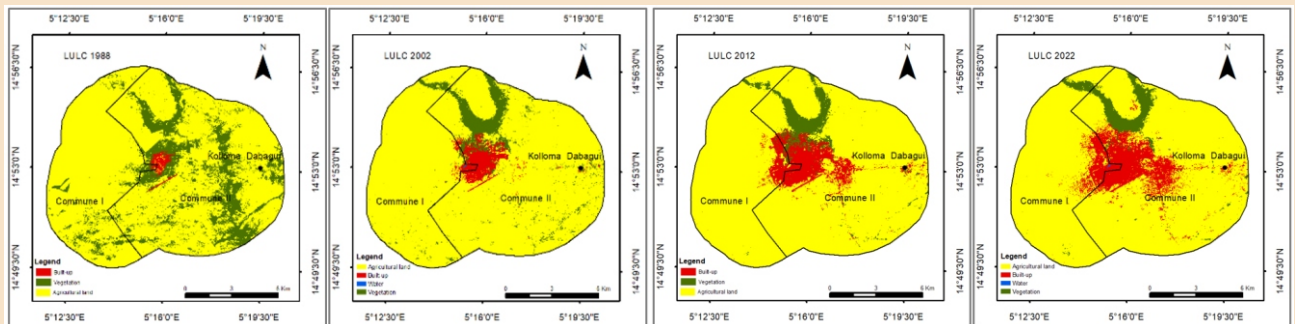


Figure 2. LULC change in Tahoua between 1988 and 2022

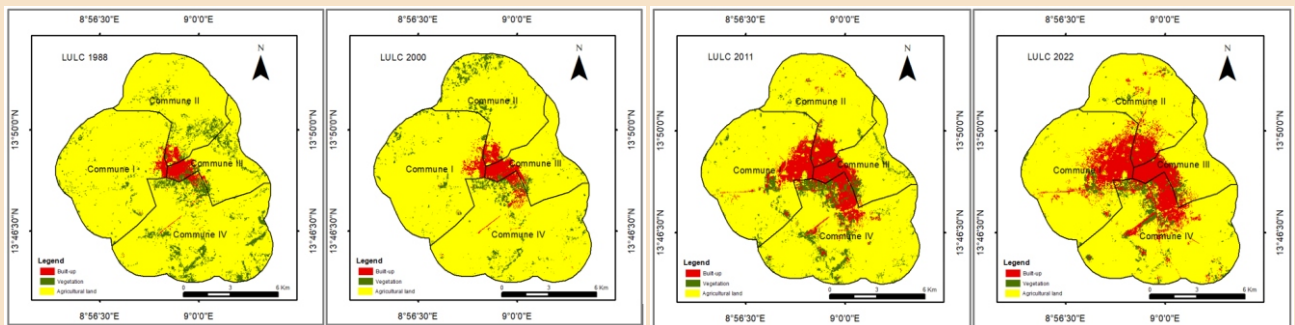


Figure 3. LULC change in Zinder from 1988 to 2022

Projected urban expansion by 2042 threatens agricultural land and vegetation in Tahoua and Zinder, risking food security and climate resilience. Policies must address unchecked sprawl through land-use regulation, green infrastructure, and protection of vital agro-ecological zones.

2. Spatiotemporal variation of LST and SUHI

Between 2002 and 2022, SUHI analysis (see Figure 4) reveals consistently high heat stress in Tahoua and Zinder's built-up zones, with specific vulnerability in Commune II and IV. This exacerbates heat-related health issues and spatial inequalities. Policies must integrate heat mitigation in urban planning, prioritising vulnerable communities through tree planting, ventilation corridors, and heat-health action plans.

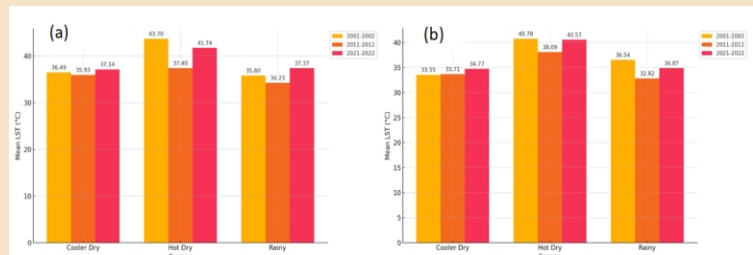


Figure 4. Distribution of Seasonal Mean LST in Tahoua (a) and Zinder (b)

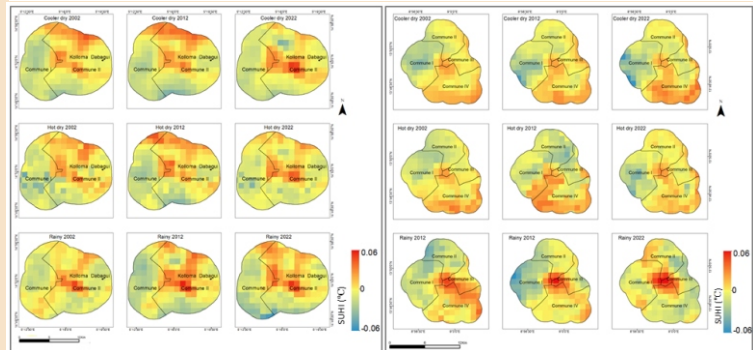


Figure 5. Distribution of Seasonal SUHI in Tahoua (a) and Zinder (b)

Projected increases in urban growth, coupled with the effects of global warming, are expected to drive a persistent rise in Land Surface Temperature (LST) across all seasons in both regions (Figure 6), underscoring the need for targeted urban planning and mitigation measures to counteract the intensifying SUHI.

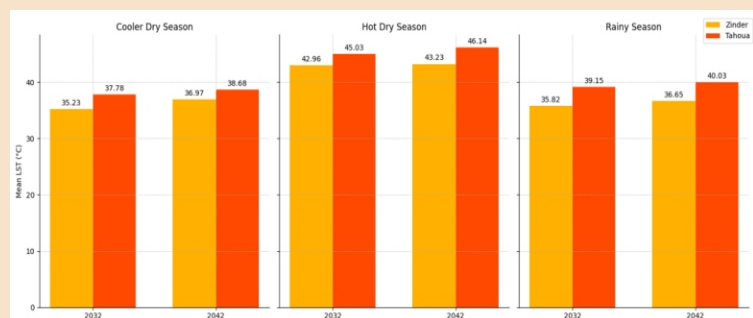


Figure 6. Future LST Mean in Tahoua and Zinder

3. Urban heat vulnerability

Vulnerable neighbourhoods in Tahoua and Zinder face intensified heat risks due to environmental and socio-economic factors. Urban planning must integrate localised resilience strategies, including cooling infrastructure, enhanced vegetation, and support for informal housing communities (Yanda Kwandagué, Bangui, Manzozo, and Garin Liman) with limited adaptive capacity.

IMPLICATION OF FINDINGS

Environmental stress from unchecked urbanisation threatens livability and health in vulnerable areas. Spatially-informed, inclusive policies are urgently needed to guide sustainable urban development and protect at-risk populations in climate-sensitive regions.

CONCLUSION

Urban expansion in Tahoua and Zinder exacerbates environmental and social vulnerabilities. Policymakers must prioritise integrated, climate-resilient planning to safeguard food systems, health, and urban livability in the face of rising heat and land use pressures.

POLICY RECOMMENDATION

To address the compounded effects of urban expansion, land degradation, and rising urban heat in Tahoua and Zinder, a spatially targeted, equity-driven urban planning framework that integrates climate-responsive zoning, compact growth, and heat-resilient infrastructure to protect vulnerable communities, preserve green spaces, and ensure inclusive, sustainable development in Tahoua and Zinder should be adopted.

Seydou, K. D., Morenikeji, W., Diouf, A., Dicko, K., Erdanaev, E., Loewner, R., & Okhimamhe, A. A. (2024). Dynamics of Zinder's Urban Landscape: Implications for Sustainable Land Use Management and Environmental Conservation. *Sustainability*, 16(23), 1-18. <https://doi.org/10.3390/su162310263>

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For further information, please contact:

Director of programme, WASCAL DRP CCHH, Federal University of Technology, PMB 65, Minna, Niger State, Nigeria
+2348136448836 wascal_cchh@futminna.edu.ng | wascal.futminna.edu.ng/