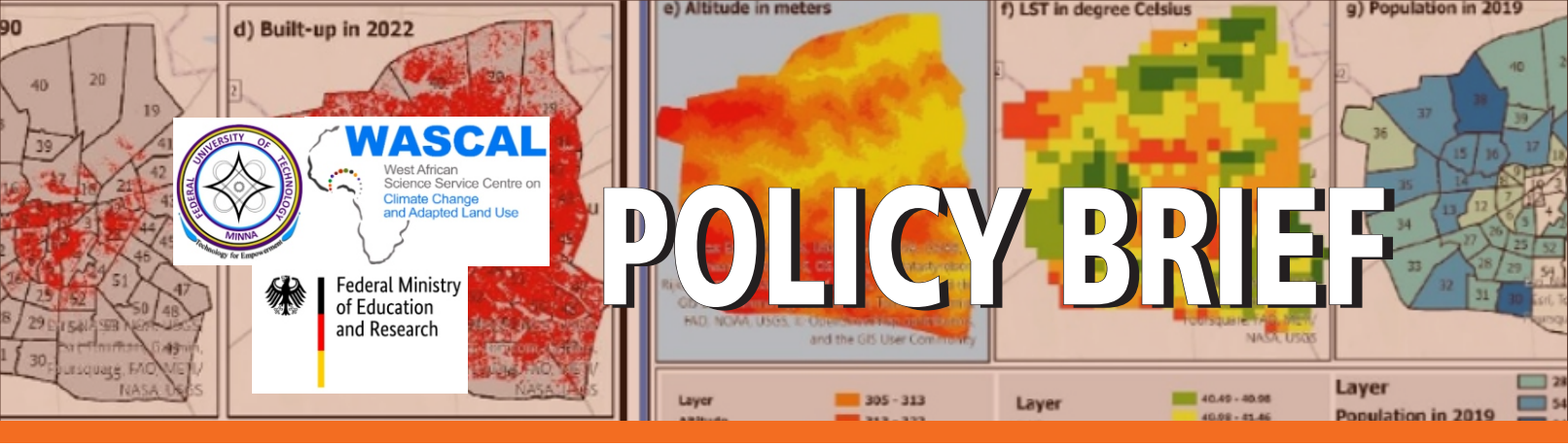

EVIDENCE-BASED ADAPTATION POLICY FROM SPATIO-TEMPORAL CLIMATE AND SETTLEMENT DYNAMICS IN ABUJA AND OUAGADOUGOU, WEST AFRICAN SAVANNAH

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EXECUTIVE SUMMARY

Rapid demographic and spatial growth are intensifying environmental hazards in cities, especially across Sub-Saharan Africa. This study examines Abuja and Ouagadougou to assess how urbanisation patterns influence heatwaves, floods, and windstorms, and to compare adaptation and mitigation strategies. Geographic Information Systems, remote sensing, and statistical modelling were integrated to trace three decades of change. Findings showed exponential population increases driving horizontal urban expansion, which amplifies exposure to extreme weather. Resulting impacts on health, thermal comfort, mobility, and activities are seen in both cities. Evidence supports risk-informed planning and climate-resilient infrastructure to reduce vulnerability in growing savannah capitals.

INTRODUCTION

By 2030, 60% of humanity will live in cities; by 2050, 68%, as urban land expands twice the population rate [1] . Urbanisation brings prosperity and services but heightens vulnerabilities in rapidly growing developing regions. Climate-smart urban practice can reduce risks. Abuja and Ouagadougou require evidence on dynamics, extremes, and adaptation pathways.

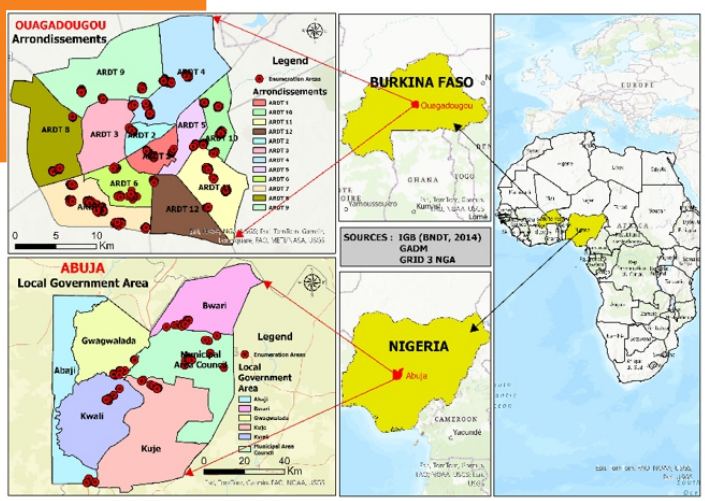

Figure 1: Location of the Study Area

RESEARCH APPROACH

Methods combined GIS, remote sensing, and statistical modelling to analyse satellite imagery, population datasets, and sociodemographic surveys from 1,680 households (Figure 2). Google Earth Engine produced land-class maps and urban expansion indices. Analytic Hierarchy Process characterised climate impacts. Logistic regressions, multiple component analysis, and ascending hierarchical classification evaluated adaptation and mitigation strategies.

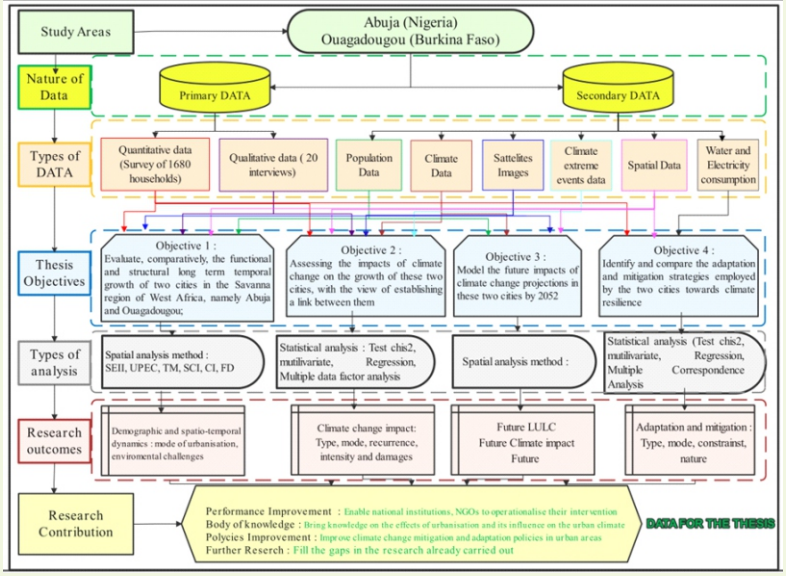

Figure 2 : Adopted Framework for the Study

KEY RESEARCH FINDINGS

(a) LULC trends and patterns in Abuja and Ouagadougou

Over three decades, Ouagadougou's LULC shifted markedly. Statistical analysis shows continuous vegetation loss and steady built-up growth. Vegetation area fell almost fourfold, while built-up expanded nearly tenfold. Cropland/bare land increased during 1990–2002, then declined by 2012 and 2022 (Figure 3). Waterbody extent showed minimal change. Annual trajectories reveal pronounced dynamics overall.

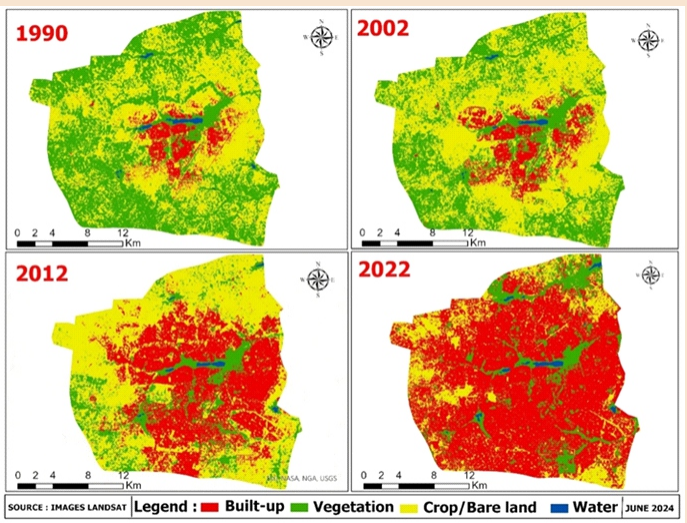

Figure 3 : Spatial Distribution of LULC in Ouagadougou

From 2001 to 2022 as shown in figure 4, Abuja saw built-up and cropland/bare land expansion, with vegetation shrinking. Dominant classes shifted: vegetation (2001), vegetation–cropland (2013), cropland (2022). Waterbody expanded until 2013, then reduced afterward.

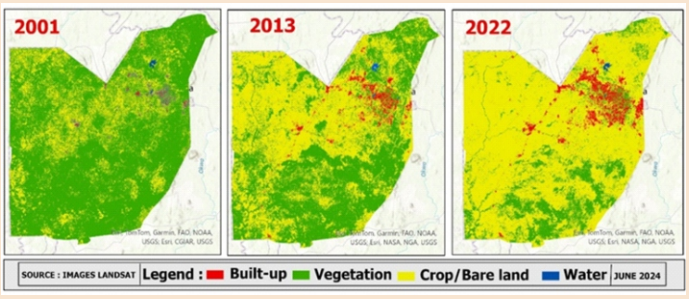

Figure 4 : Spatial Distribution of LULC in Abuja

(b) Future land use and land cover trends in Abuja and Ouagadougou

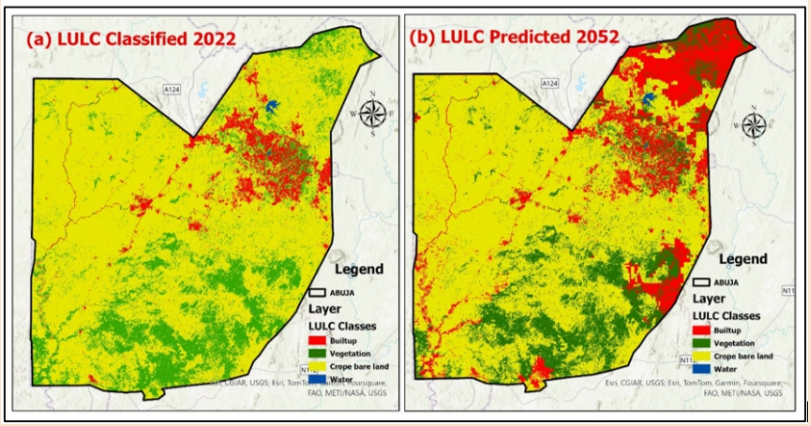

Figure 5 Spatial Distribution of LULC Classified in 2022 (a) and Predicted in 2052 (b)

By 2052, Abuja's built-up will triple from 5% (Figure 5), reaching approximately 812 square kilometres. Cropland/bare land will increase by approximately 10%. Vegetation will decrease from 18% to approximately 1%, implying approximately 1,331.77 square kilometres loss. The results forecast future severe ecological depletion without intervention.

Figure 6 shows that by 2052, Ouagadougou's built-up will rise from 70% to 94% (502.41 square kilometres). Cropland/bare land will decline from 16% to 3%. Vegetation will shrink from 12.92% to 3%, with an estimated 71.96 square kilometres lost.

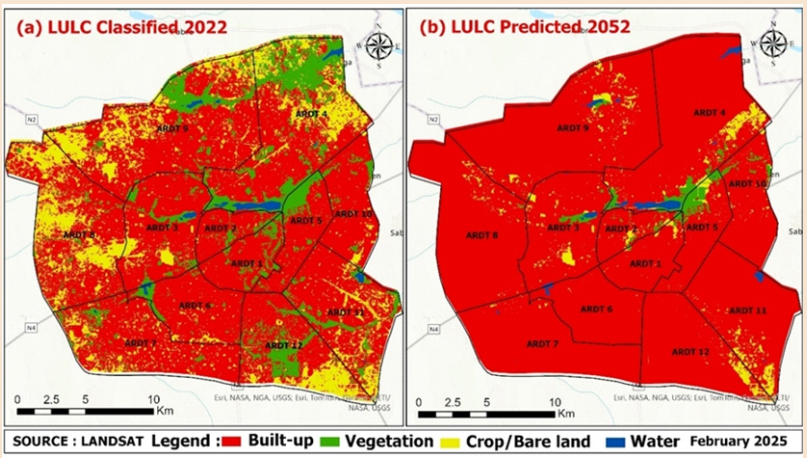

Figure 6: Spatial Distribution of LULC Classified in 2022 (a) and Predicted in 2052 (b)

(c) Socio-demographic characteristics and climate change adaptation

The analyses linked adaptation with socio-demographics: higher education predicted permanent air Conditioner/fan use and visits to forests, gardens, green spaces; age increased visits; occupation e.g. public, private, students, researchers readily adopt cooling and nature-based strategies [2].

CONCLUSION

Across three decades, population and housing have expanded rapidly. Heat, floods, and windstorms affect health unevenly across Abuja LGAs and Ouagadougou sectors. Households face multiple hazards; adaptation strategies adopted differ between cities.

POLICY RECOMMENDATION

The Ministry of Urban Planning must adopt a Risk-Informed, Climate-Resilient Urban Development Policy that prohibits settlement in marshes/floodplains, curbs environmentally harmful informality, and aligns housing, infrastructure, energy, and mobility with future climate projections. The key action pillars (With the Ministries of environment, energy, infrastructure and transport) are:

(a) Risk-based land use & relocation (Urban Planning): Enforce hazard zoning; resettle from floodplains to serviced safe sites.

(b) Sustainable, climate-ready housing (Housing/Urban Dev.): Mandate resilient, energy-efficient, affordable designs using future climate projections.

(c) Resilient urban infrastructure (Urban Planning/Public Works): Upgrade drainage; expand green infrastructure and permeable surfaces.

(d) Clean energy transition (Energy): Incentivize solar, wind, biogas; adopt and enforce building energy codes.

(e) Mass transit first (Transport/Urban Mobility): Invest in BRT/rail, improve buses, drive mode shift from cars.

(f) Governance & finance (PMO/Finance): Inter-ministerial task force, climate-budget tagging, mobilize green/climate funds.

[1] Y. Chen, H. Cai, and Y. Chen, "Spatial correlation and interaction effect intensity between territorial spatial ecological quality and new urbanization level in Nanchang metropolitan area, China," Ecol. Indic., vol. 156, p. 111163, Dec. 2023, doi: 10.1016/j.ecolind.2023.111163.

[2] A. Gadiaga, A. A. Okhimamhe, M. Thiel, and O. Neya, "Adaptation and Mitigation Strategies of the Populations of Abuja and Ouagadougou in West Africa to the Various Impacts of Extreme Climate Events in Urban Areas," Climate, vol. 13, no. 7, p. 132, Jun. 2025, doi: 10.3390/cli13070132.

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