STRATEGIC POLICY PATHWAYS FOR ENHANCING URBAN VEGETATION TO ADDRESS HEAT STRESS AND CARBON EMISSIONS IN WEST AFRICAN CITIES

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EXECUTIVE SUMMARY

Rapid urbanisation across the Global South intensifies heat stress, reduces biodiversity, and complicates sustainable planning. This study examines plant diversity and climate resilience in two West African cities by linking household surveys with urban greenery assessments. Results show that homeownership and long-term residence, not wealth, are the strongest predictors of biodiversity (Ahouandjinou et al., 2024). Rented properties and homogenous urban landscapes reduce plant diversity, weakening cooling effects at local scales. Alien species diversify lineages but diminish native richness. The study highlights how urban greenery can mitigate temperature extremes and support biodiversity, offering insights for city planners seeking climate-resilient, inclusive, and sustainable urban development.

INTRODUCTION

Urbanisation drives the urban heat island effect, worsening heat risks and environmental stress. This study examines how plant diversity, land use, and socioeconomic factors influence local climate regulation in West African cities of Abuja and Lagos (in Nigeria); Parakou and Cotonou (in Benin Republic), highlighting the role of functional and phylogenetic traits in guiding greening strategies for resilience and sustainability (see Figure 1).

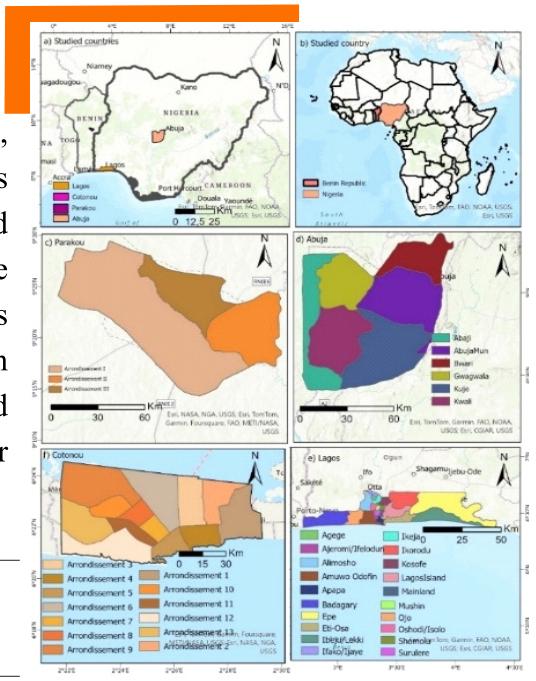

Figure 1: Study Area Showing the City of Parakou © and the City of Cotonou (F) With their Districts and the City of Abuja (D) and the City of Lagos (E).

RESEARCH APPROACH

By combining household surveys, plant diversity assessments, remote sensing, and structural equation modeling, this study reveals how socioeconomic and ecological dynamics jointly shape biodiversity conservation and heat mitigation in West African cities (see Figure 2)

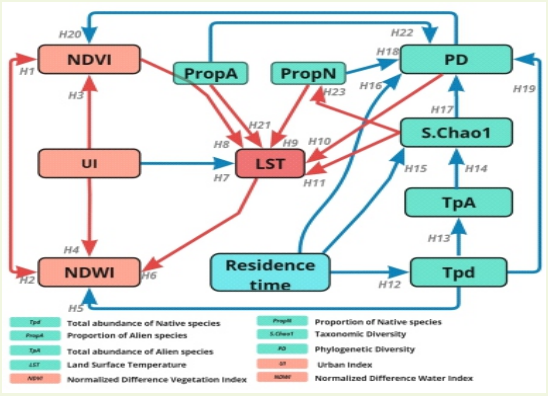

Figure 2: Conceptual Model Highlighting Different Hypotheses Tested in This Study Where Reddish Arrow Denotes Positive Hypothetical Relationships and Blue Arrows Denote Negative Relationships Between the Predictors and the Response Variable

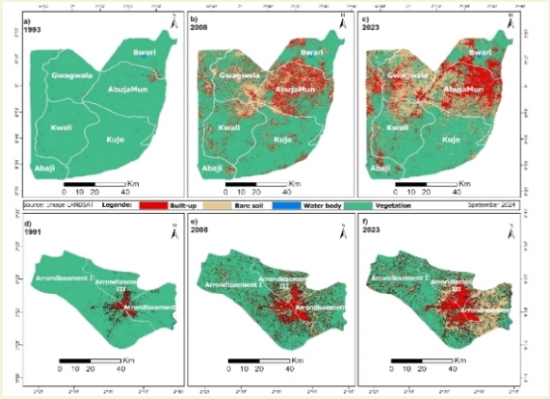

Figure 3: Land Use and Land Cover Distribution in Abuja (a-c), Parakou (d-f), from 1991–2023: Green (Vegetation), Red (Built-Up), Blue (Water), and Maroon (Bare Soil/Rocks)

KEY RESEARCH FINDINGS

1. Socioeconomic Factors Influence Urban Plant Diversity

Urban plant diversity reflects socioeconomic factors. Renters and male-headed households sustain lower diversity, while cultural attachment narrows species choices. Findings challenge the luxury effect and emphasize inclusive greening policies ensuring all demographic groups access and contribute to biodiversity conservation, fostering equity and resilience in West African cities (see Figure 4).

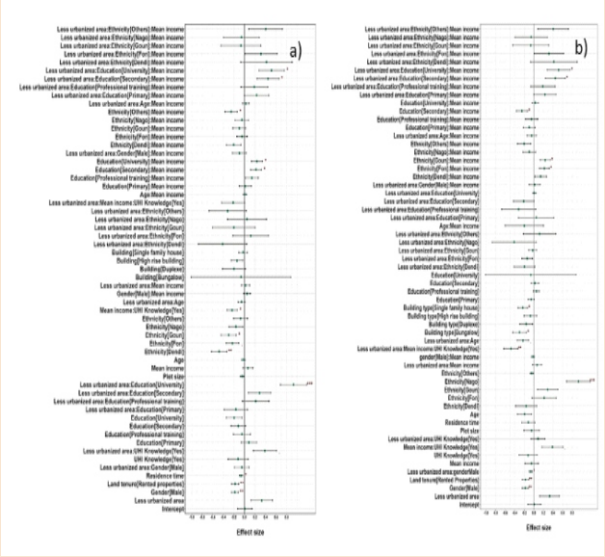

Figure 4: Effects of Socioeconomic Factors and UHI Knowledge on Household Phylogenetic Diversity (a) and taxonomic diversity (b)

2. Urbanization Impacts Biodiversity Distribution

Urban expansion shifts plant diversity patterns: taxonomic richness survives in less urbanized areas, but phylogenetic diversity declines. Residence time reduces species richness, and built-up areas erode evolutionary distinctiveness. Findings highlight integrating biodiversity conservation into urban planning to mitigate ecological losses in rapidly growing cities (see Figure 4).

3. Plant Diversity Supports Climate Regulation

Urban plant phylogenetic diversity correlates with plant taxonomic richness and reduced land surface temperatures. Higher Normalised Difference, Vegetation Index (NDVI) further reduced heat, confirming that diverse, greener urban communities enhance cooling and resilience against climate stress. Findings highlight promoting phylogenetically diverse species as a nature-based solution for urban heat mitigation and resilience in city planning (see Figure 6 and 8).

4. Water Availability and Built-Up Areas Shape Urban Climate

Urbanization reduces water availability, intensifying heat islands and limiting vegetation growth. NDWI–LST analysis confirms water bodies' cooling effect. Findings emphasize integrating wetlands, green-blue infrastructure, and sustainable water management into urban planning to conserve biodiversity and build climate resilience (see Figures 3, 4, 5, and 6).

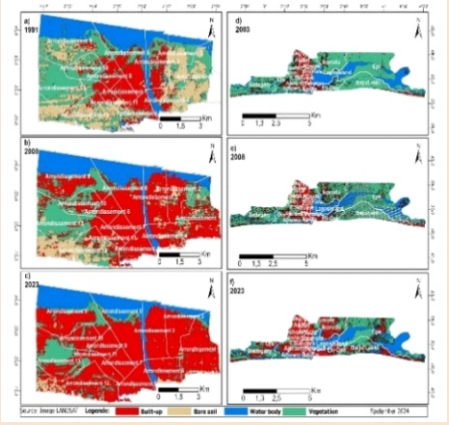

Figure 4: Land Use and Land Cover Distribution in Cotonou (a-c), Lagos (d-f), from 1991–2023: Green (Vegetation), Red (Built-Up), Blue (Water), and Maroon (Bare Soil/Rocks)

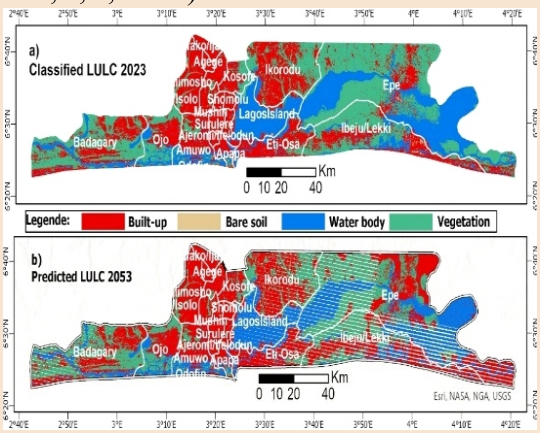

Figure 5: Spatial Distribution of LULC in 2023 (a), and projected for 2053 (b) in Lagos

5. Alien Species Influence Urban Biodiversity

Alien species enrich phylogenetic diversity by introducing distinct lineages but reduce taxonomic richness, homogenizing urban flora. This trade-off highlights risks to native ecosystems, stressing policies that balance alien introductions with native conservation to sustain biodiversity and ecosystem functionality in urban environments.

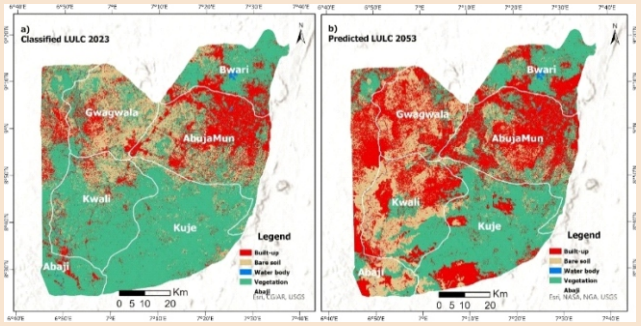

Figure 7: Spatial Distribution of LULC in 2023 (a), and projected for 2053 (b) in Abuja

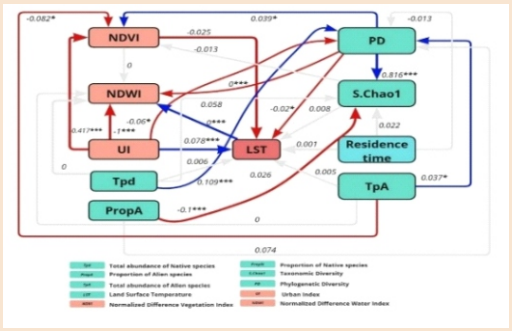

Figure 8: Direct and Indirect Relationships Between Land Surface Temperature (LST), Vegetation Indexes and Urban Attributes at the Four City Scale

IMPLICATION OF FINDINGS

These findings emphasize strategic greening: prioritizing phylogenetic diversity, addressing plant disparities in rented housing, integrating socioeconomic equity, and selecting heat-regulating species to maximize biodiversity and climate resilience in urban landscapes.

CONCLUSION

Socioeconomic disparities influence conservation indirectly through residence and attachment. Built-up footprint raises LST, while higher phylogenetic diversity cools regionally. Education and gender empowerment are critical levers for biodiversity management strategies.

POLICY RECOMMENDATION

Urban greening in West African cities should adopt a strategic, inclusive, and data-driven approach that prioritises phylogenetically diverse native species, incentivizes greenery in rented and low-income properties, integrates socioeconomic equity into planning, and establishes robust monitoring systems. Implementation should be led by municipal governments (e.g., Lagos State Ministry of Environment in Nigeria, Cotonou City Council in Benin), in partnership with national agencies such as the Federal Ministry of Environment of Nigeria and the Ministry of Living Environment and Sustainable Development of Benin. Regional organisations, including the Economic Community of West African States (ECOWAS), the West African Economic and Monetary Union (WAEMU), and the African Development Bank (AfDB), should support coordination, financing, and cross-border knowledge sharing. By aligning biodiversity conservation with climate action and social development, this policy framework can mitigate urban heat islands, strengthen resilience, and ensure equitable access to the benefits of green infrastructure for urban residents across the region.

Ahouandjinou, E. B. O., Gaoue, O. G., Olutoye, M. A., Fassnacht, F. E., & Okhimamhe, A. A. (2024). Contrasting luxury effect on urban plant phylogenetic and taxonomic diversity in West African cities. Ecosystems and People, 20(1), 2382834. https://doi.org/10.1080/26395916.2024.2382834

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