URBAN EXPANSION IN WEST AFRICAN CITIES

STRENGTHENING URBAN RESILIENCE IN TOGO AND GHANA THROUGH ECOSYSTEM SERVICES INTEGRATION AND ECOLOGICAL SUSTAINABILITY FOR CLIMATE ADAPTATION

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EXECUTIVE SUMMARY

This study examines the impact of rapid urban expansion on ecosystem services in West African cities, focusing on District Autonome du Grand Lomé (DAGL) in Togo and Greater Accra Metropolitan Area (GAMA) in Ghana. Using remote sensing and geographic information system (GIS) techniques, it reveals significant losses of green spaces, agricultural land, and natural habitats, threatening food security, climate resilience, and urban quality of life. The findings highlight the urgent need for integrated urban planning and strengthened environmental governance.

INTRODUCTION

Accelerated, unplanned urbanization in West African cities is pushing urban centres, such as the District Autonome du Grand Lomé (DAGL) and Greater Accra Metropolitan Area (GAMA) into surrounding rural landscapes (Figure 1 a & b). Sprawl driven by population growth, migration, economic opportunities, and insufficient planning regulations (GSS, 2021; INSEED, 2022), is degrading vital ecosystems that provide critical services including, carbon storage and sequestration, flood risk reduction, and climate regulation. The resulting ecosystem fragmentation worsens vulnerability to climate risks, undermining urban resilience. Building resilient cities in Togo and Ghana requires stronger urban policies that embed ecosystem preservation and ecological sustainability as central pillars of urban development.

Figure 1: (a): Dense built-up area, minimal green cover (Source: https://earth.google.com/)
(b): Greened Urban Core (Source: togo-africa-lome.jpg)

RESEARCH APPROACH

This study applies multispectral remote sensing and GIS to evaluate directional urban expansion in DAGL and GAMA (Figure 2) from 1986–2023. Using Google Earth Engine and supervised classification of Landsat imagery, land cover changes were mapped and combined with meteorological datasets in the InVEST model. The assessment quantified impacts on carbon sequestration, urban cooling, and flood mitigation services.

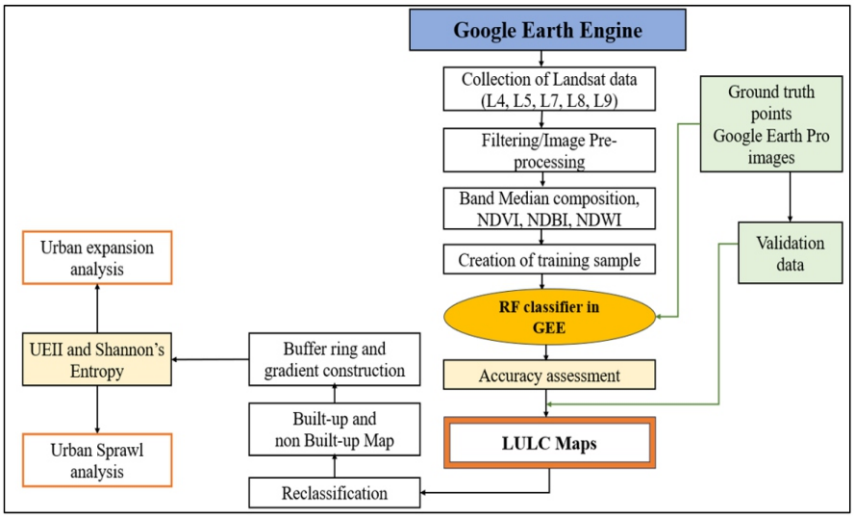

Figure 2 : Flowchart for LULC/urban expansion and sprawl analysis

KEY RESEARCH FINDINGS

1. Land use and land cover change in DAGL and GAMA

Over 37 years, DAGL and GAMA have shifted from vegetation-dominated landscapes to urbanized footprints. In DAGL, built-up areas rose from less than 25% in 1986 to 76% by 2023. Similarly, GAMA's urban land expanded to 70% by 2023, largely replacing forests, grasslands, and farmland (Figure 3). These trends reveal accelerated urban encroachment on natural ecosystems.

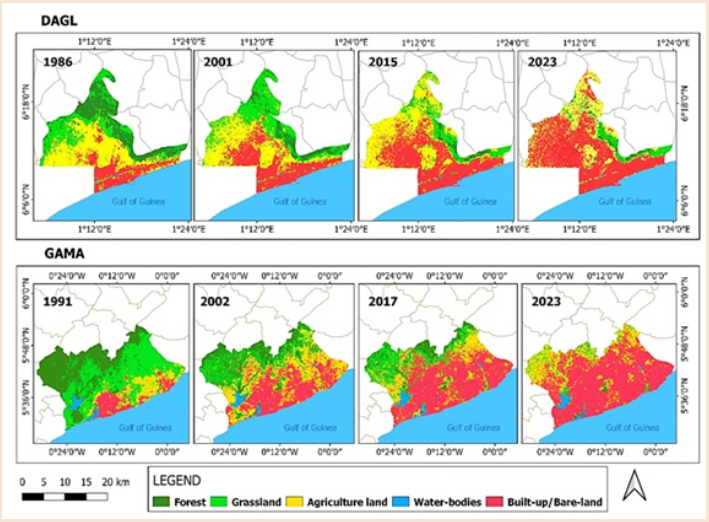

Figure 3 : Land use and land cover map of DAGL and GAMA

2. Urban expansion dynamics

In DAGL and GAMA, urban expansion is intensifying, with UEII values of 1.05%–1.92% revealing peri-urban growth and entropy indices close to 1 indicating fragmentation. Expansion directions vary northwest in DAGL and northeast-northwest in GAMA. These findings stress the need for planning frameworks that anticipate directional growth while mitigating landscape fragmentation and unsustainable land conversion (Figure 4 and 5).

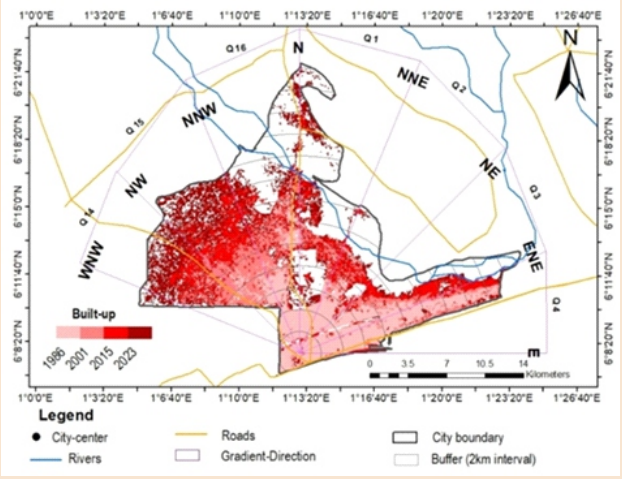

Figure 4: Spatial orientation of urban expansion in DAGL

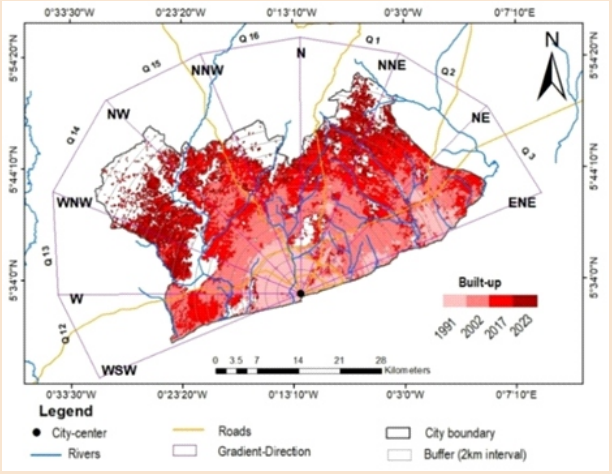

Figure 5: Spatial orientation of urban expansion in GAMA

3. Nature and Changes in Ecosystem Services

Between 1986 and 2023 in DAGL and 1991–2023 in GAMA, carbon storage sharply declined, falling from 3.6 to 1.4 million Mg C and 16.6 to 4.1 million Mg C, respectively (Figure 6). Declines in heat regulation capacity and runoff retention highlight worsening urban heat island effects and rising flood risk, underscoring the ecological consequences of unchecked urbanization.

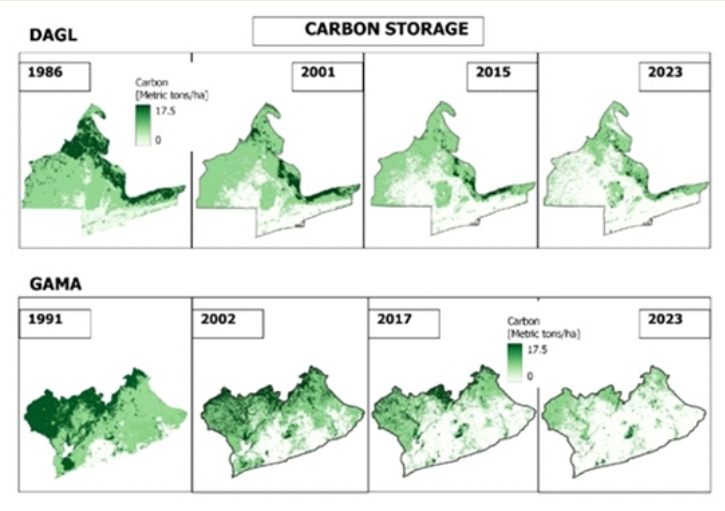

Figure 6: Carbon storage map of DAGL and GAMA

4. Extent of the impact of urban expansion on ecosystem services

Urban expansion in DAGL and GAMA strongly reduces ecosystem services, with carbon storage correlations at -0.97 and -0.92, and temperature regulation at -0.96. Vegetation loss drives these declines, underscoring the ecological consequences of metropolitan growth.

IMPLICATION OF FINDINGS

In DAGL and GAMA, urban expansion shows strong negative correlations with carbon storage (-0.97, -0.92) and temperature regulation (-0.96). Vegetation loss drives these declines, emphasizing the ecological costs of metropolitan growth.

CONCLUSION

The significant loss of ecosystem services in DAGL and GAMA undermines urban resilience and climate adaptation, underscoring the need to develop green infrastructure, such as urban parks and ecological corridors, to enhance carbon storage and thermal regulation. Promoting controlled urban densification can limit impervious surface expansion and vegetation loss while enhancing climate-resilient urban form.

POLICY RECOMMENDATION

The rapid decline of ecosystem services in DAGL and GAMA demands urgent, multi-level action involving coordinated efforts across local governments, national ministries, regional bodies, NGOs, and research institutions. To reverse ecosystem degradation and enhance urban resilience, it is essential to promote green infrastructure development such as urban parks and ecological corridors that enhance carbon storage and heat mitigation. Controlled urban densification should be encouraged to limit the expansion of impermeable surfaces and prevent further vegetation loss. Strict regulatory frameworks for soil management and ecosystem protection must be implemented, alongside ecological compensation measures integrated into development projects. Raising awareness among local stakeholders and establishing robust monitoring of environmental indicators are critical to ensuring policy effectiveness and sustaining climate resilience in these metropolitan areas.

INSEED, Résultats Définitifs du RGPH-5 (Novembre 2022). Available online: https://inseed.tg/resultats-definitifs-du-rgph-5 novembre-2022/ (accessed on 7 July 2023).

GSS. Ghana 2021 Population and Housing Census. General Report. 2021. Available online: https://www.bing.com/search?q=Ghana+2021+Population+and+Housing+Census+General+Report+pdf (accessed on 10 January 2023).

Tossoukpe, A.Y.; Dukiya, J.; Folega, F.; Thiel, M.; Okhimamhe, A. A. (2025). Dynamics of Changes in Spatial Patterns of Built-Up Areas in Two Metropolitan Areas of Grand Lomé and Greater Accra (West Africa). Urban Science, 9, 84. https://doi.org/ 10.3390/urbansci9030084

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