



Review Article

Economic Trees as Nature-Based Solutions for Climate-Resilient Urbanism: Insights from Benue State, Nigeria

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Abstract—African cities are at the frontline of climate change, facing rising temperatures, erratic rainfall, flooding, and worsening environmental quality. In Nigeria, rapid urban expansion frequently outpaces infrastructure provision, exacerbating climate vulnerabilities and deepening social inequalities. This paper advances the argument that economic tree species cultivated for both ecological services and economic value offer a cost-effective, culturally embedded form of nature-based solutions (NbS) for climate-resilient urbanism. Drawing on insights from Benue State, Nigeria, the study synthesizes empirical evidence and theoretical perspectives to demonstrate how trees such as mango (*Mangifera indica*), cashew (*Anacardium occidentale*), moringa (*Moringa oleifera*), neem (*Azadirachta indica*), and oil palm (*Elaeis guineensis*) contribute to urban adaptation. The findings highlight that economic trees simultaneously mitigate urban heat islands, sequester carbon, regulate stormwater, and enhance biodiversity while providing food, medicine, raw materials, and income opportunities. Their multifunctionality situates them at the intersection of ecological modernization, resilience theory, and sustainable urbanism, offering a practical model for integrating green infrastructure into rapidly urbanizing contexts. However, weak policy frameworks, inadequate maintenance, and competing land-use priorities currently undermine their potential. The paper argues for embedding economic trees into urban planning frameworks, supported by community participation, livelihood-oriented incentives, and species-appropriate technical guidelines. By foregrounding a Global South perspective, the study contributes to global debates on NbS and sustainable urbanism, demonstrating that resilience can be pursued not only through imported models but also through locally grounded ecological practices that are socially equitable and economically viable.

Article Key Information

Keywords: Economic trees; nature-based solutions; climate-resilient urbanism; sustainable urbanism; Benue State

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1.0 Introduction

Cities across the globe are increasingly recognized as critical frontlines in the struggle against climate change. Rapid urbanization, particularly in the Global South, is transforming landscapes at an unprecedented pace, intensifying exposure to environmental risks such as heat waves, flooding, and deteriorating air quality (United Nations Human Settlements Programme [UN-Habitat], 2020). In Africa, where urban growth rates rank among the highest worldwide, the intersection of fragile infrastructure, socio-economic inequalities, and climate pressures creates acute vulnerabilities for urban populations (Intergovernmental Panel on Climate Change [IPCC], 2022). Nigeria exemplifies these dynamics. Its urban centers, including those in Benue State, are experiencing expansion that frequently outpaces infrastructure provision, thereby amplifying susceptibility to climate-induced hazards. Against this backdrop, integrating nature-based solutions into urban design emerges as an urgent and cost-effective pathway for enhancing climate resilience.

Urban design, once narrowly associated with the spatial arrangement of buildings and aesthetics, is increasingly conceived as a multidisciplinary field that integrates ecological functions, community well-being, and long-term sustainability (Beatley, 2011; Carmona, 2014). The shift reflects a broader recognition that cities are not merely physical agglomerations of infrastructure but socio-ecological systems whose health and resilience depend on dynamic interactions between natural and built environments (Elmqvist et al., 2019). Nature-based strategies such as green infrastructure, urban forestry, and ecological corridors are now central to urban sustainability discourse, valued for their ability to mitigate heat stress, regulate stormwater, improve air quality, and foster social cohesion (Gill et al., 2007; Tzoulas et al., 2007). Within this paradigm, the role of trees—long appreciated for their environmental benefits—is being re-examined through a more holistic lens that connects ecology, economy, and culture.

Economic trees, defined as species cultivated for both ecological functions and economic value, provide a particularly promising yet underexplored avenue in climate-resilient urbanism. Unlike purely ornamental species, economic trees deliver multifunctional benefits. They act as carbon sinks and microclimate regulators while simultaneously producing fruits, oils, nuts, timber, and medicinal products (Food and Agriculture Organization [FAO], 2016). These attributes situate them at the nexus of climate adaptation and livelihood sustenance, making them uniquely relevant for contexts such as Benue State, where agriculture remains the backbone of the economy and household welfare. In this regard, species such as mango (*Mangifera indica*), cashew (*Anacardium occidentale*), moringa (*Moringa oleifera*), neem (*Azadirachta indica*), and oil palm (*Elaeis guineensis*) are not only ecological assets but also socio-economic lifelines embedded in local cultural practices.

The urgency of foregrounding economic trees in urban design for Benue State stems from the dual pressures of climate variability and rapid urban growth. Rising temperatures, erratic rainfall, and flooding already undermine environmental quality and public health in cities like Makurdi (Ikyaagba, Nanen, & Tee, 2023). At the same time, unplanned urban expansion often prioritizes roads, housing, and commercial spaces at the expense of green infrastructure (Akinbode & Komolafe, 2021). The result is an urban landscape where ecological buffers are eroded, exacerbating climate impacts and deepening social inequities. Although households and schools sometimes plant fruit trees within their compounds, systematic integration of economic trees into city planning remains limited. This gap reflects not only weak policy frameworks but also a broader neglect of locally available, low-cost, and culturally resonant adaptation strategies.

The global discourse on resilience and sustainability underscores the significance of rethinking such locally grounded interventions. Resilience theory conceptualizes cities as complex adaptive systems, emphasizing diversity, redundancy, and adaptability as critical attributes for withstanding shocks (Holling, 1973; Walker, Holling, Carpenter, & Kinzig, 2004). Similarly, sustainable urbanism advocates compact, ecologically integrated, and socially inclusive development that balances human needs with environmental stewardship (Farr, 2007; Newman & Jennings, 2008). Within these frameworks, economic trees emerge as a convergence point. They embody ecological design principles

by embedding natural systems within built environments, enhancing resilience by moderating climate extremes, and advancing sustainability by generating socio-economic and cultural co-benefits.

Empirical evidence from Nigeria reinforces these theoretical claims. Studies in Ilorin and Enugu highlight how urban tree diversity and household adoption of fruit-bearing species strengthen ecological resilience and local livelihoods (Apeh, Agbugba, & Mdoda, 2023; Moshood, Muhali, & Ugbong, 2024). Research in Makurdi has shown that canopy cover from trees reduces indoor temperatures by up to 3.6 °C, significantly improving thermal comfort and reducing energy demand (Ikyaaqba et al., 2023). Similarly, willingness-to-pay studies in Benin City and Makurdi reveal residents' tangible valuation of the ecosystem services provided by urban trees, from air purification to flood control (Arabomen, Chirwa, & Babalola, 2019; Sambe, Aondona, & Egba, 2021). These findings affirm that economic trees are not only ecologically effective but also socially acceptable and economically valued by urban residents.

Despite these demonstrated benefits, several constraints hinder the systematic adoption of economic trees in Nigerian urban centers. Weak institutional coordination, fragmented policy frameworks, inadequate maintenance, and competition for urban land undermine tree-based interventions (Alfa & Ancha, 2019). Furthermore, the preference for exotic ornamental species over indigenous economic trees reflects a planning bias that overlooks the multifunctional advantages of local species. Such gaps underscore the need for policy reforms that embed economic trees within zoning codes, building regulations, and city master plans, supported by community participation and livelihood-oriented incentives.

The objective of this paper is to examine the role of economic trees in advancing climate-resilient urban design, with a particular focus on Benue State, Nigeria. It analyzes the environmental, socio-economic, and infrastructural impacts of economic trees while critically assessing the barriers to their integration. Drawing on ecological modernization, resilience theory, and sustainable urbanism, the paper positions economic trees as essential nature-based assets capable of transforming climate vulnerabilities into opportunities for sustainable development. In so doing, it contributes to broader debates on how African cities can reconcile rapid urbanization with the urgent imperative of building climate resilience.

2.0 Conceptual Clarifications and Theoretical Framework

2.1 Conceptual Clarifications

Economic Trees

Economic trees are woody plant species cultivated not only for ecological functions but also for their capacity to generate direct and indirect socio-economic value. They differ from ornamental trees by simultaneously providing ecological services (such as carbon sequestration, air purification, and microclimate regulation) and economic benefits in the form of fruits, nuts, oils, timber, medicinal extracts, and non-timber products (FAO, 2016). Examples widely cultivated in Nigeria and particularly in Benue State include mango (*Mangifera indica*), cashew (*Anacardium occidentale*), neem (*Azadirachta indica*), moringa (*Moringa oleifera*), and oil palm (*Elaeis guineensis*). These species are multifunctional, serving as food security buffers, income sources, cultural symbols, and ecological stabilizers. Their unique value lies in their integration of livelihood support with environmental resilience, which makes them particularly relevant to nature-based urban design.

Urbanism and Urban Design

Urbanism refers to the socio-spatial processes that shape cities, encompassing their physical, social, economic, and ecological dimensions (Wheeler, 2013). Urban design, a subset of urbanism, involves the intentional organization of built and open spaces, transport systems, and landscapes to enhance functionality, aesthetics, and quality of life

(Carmona, 2014). In contemporary scholarship, urban design is viewed not merely as a spatial discipline but as a framework for embedding sustainability, resilience, and equity into the urban fabric (Beatley, 2011). This broader understanding allows economic trees to be conceptualized as critical design elements that simultaneously soften infrastructure, provide shading, and enrich ecological and social systems.

Climate Resilience

Climate resilience is defined as the capacity of socio-ecological systems to anticipate, absorb, adapt to, and recover from climate shocks and stresses while maintaining essential functions and structures (IPCC, 2022). Within urban contexts, resilience entails designing systems and spaces that reduce exposure to hazards such as floods, heat waves, and pollution while strengthening adaptive capacities of communities and institutions (Elmqvist et al., 2019). Economic trees are integral to such resilience because they mitigate urban heat, regulate stormwater, support biodiversity, and reduce energy demand for cooling—all while delivering co-benefits that enhance human well-being and social equity.

Nature-Based Solutions (NbS)

Nature-Based Solutions are interventions that use natural processes and ecosystems to address societal challenges such as climate change, food security, and human health, while delivering biodiversity and livelihood benefits (European Commission, 2015). As a concept, NbS builds on earlier discourses of ecosystem services and green infrastructure but emphasizes the intentional design and governance of natural assets for resilience and sustainability (Kabisch et al., 2016). Economic trees fit squarely within this paradigm, representing a localized, culturally grounded form of NbS that is both accessible and cost-effective for African cities.

2.2 Theoretical Framework

This study is anchored in three complementary theoretical perspectives: ecological modernization, resilience theory, and sustainable urbanism, each offering a lens for interpreting the multifunctional role of economic trees in urban design.

Ecological Modernization (EM)

Emerging in Europe in the 1980s, ecological modernization theory argues that environmental protection and economic growth can be reconciled through technological innovation, policy reform, and ecological integration into development processes (Huber, 1982; Mol, 1995). Rather than viewing ecology as a constraint, EM positions it as an opportunity for efficiency, innovation, and competitiveness (Mol & Spaargaren, 2000). Applied to the Nigerian urban context, EM supports the notion that embedding economic trees into city planning is not a hindrance to urban expansion but a strategy to enhance environmental performance while generating economic dividends. While critics caution that EM may underestimate structural inequalities and governance limitations in the Global South (York & Rosa, 2003), its pragmatic orientation underscores feasible entry points such as tree planting policies, tax incentives, and eco-sensitive design that can bridge growth and resilience in Benue State.

Resilience Theory

First articulated by Holling (1973) in ecology, resilience theory conceptualizes systems as dynamic, adaptive, and capable of absorbing shocks while reorganizing to maintain function. In urban studies, resilience theory highlights diversity, redundancy, and adaptive capacity as crucial attributes of resilient socio-ecological systems (Walker et al., 2004). Economic trees exemplify these principles: they provide diverse benefits (food, medicine, shade, and cultural value), redundancies that buffer against shocks (e.g., perennial fruit supply during crop failures), and adaptive

functions that reduce vulnerability to climate extremes. Critics argue that resilience discourse can sometimes be vague or shift responsibility to communities without addressing governance failures (Davoudi, 2012; Cote & Nightingale, 2012). Nevertheless, resilience theory offers a powerful foundation for understanding how economic trees can enhance adaptive capacity at both household and city levels in Benue State.

Sustainable Urbanism

Sustainable urbanism emphasizes compact, walkable, transit-oriented, and ecologically integrated urban forms that promote social equity and environmental stewardship (Farr, 2007; Newman & Jennings, 2008). It extends the Brundtland Report's (1987) vision of sustainable development into city-making, stressing that urban growth should align with ecological and social imperatives. Within this framework, economic trees can be seen as vital green infrastructure that balances human needs with ecological processes. By embedding fruit-bearing and multipurpose trees into housing estates, markets, and road networks, cities in Benue State can create healthier, more livable, and more equitable environments. While critics caution that sustainable urbanism can be idealistic or overlook local contexts (Hodson & Marvin, 2010), its holistic perspective validates the integration of economic trees as both practical and symbolic assets in climate-resilient urban design.

Taken together, these three perspectives converge to highlight economic trees as multifunctional, cost-effective, and culturally embedded nature-based solutions. Ecological modernization emphasizes their potential for linking growth and ecology; resilience theory underscores their role in adaptation and redundancy; and sustainable urbanism situates them within holistic strategies for equitable and livable cities. This integrated framework provides a robust basis for analyzing the environmental, socio-economic, and infrastructural contributions of economic trees to climate-resilient urbanism in Benue State.

3.0 Literature Review and Empirical Context

Urban greenery, particularly trees, has long been recognized as a critical component of sustainable city development, with evidence spanning ecological, socio-economic, and cultural dimensions. A growing body of global scholarship demonstrates that trees mitigate climate change by sequestering carbon, reducing ambient temperatures, regulating stormwater, and supporting biodiversity (Gill et al., 2007; Poulidakos & Kassomenos, 2014). These environmental services are not merely aesthetic; they constitute cost-effective adaptation strategies that enhance human well-being and reduce urban vulnerability to climate extremes (Elmqvist et al., 2019). Within the African context, where cities face heightened exposure to climate risks and limited adaptive infrastructure, the integration of trees into urban planning acquires particular urgency.

Recent studies in Nigeria and other African urban centers have underscored the multifunctionality of urban trees. Evidence consistently highlights their capacity to regulate microclimates. For instance, empirical assessments in Makurdi and Ilorin demonstrate that canopy cover reduces indoor wall temperatures by an average of 3–4 °C, directly lowering heat stress and energy demand for cooling (Ikyaagba, Nanen, & Tee, 2023; Moshood, Muhali, & Ugbong, 2024). Such findings resonate with international studies in Asia and Europe that link tree density to reductions in the urban heat island effect, confirming the global transferability of ecological benefits (Jim & Chen, 2009; McPherson, Simpson, Peper, & Xiao, 1999). What is distinctive in the Nigerian context, however, is the dual ecological–economic role of economic trees, which simultaneously provide climate regulation and livelihood resources. This multifunctionality positions them as an especially relevant form of nature-based solution (NbS) in low- and middle-income cities.

The socio-economic contributions of urban trees have also been widely documented. In Nigeria, fruit-bearing species such as mango, cashew, and guava are cultivated across both rural and urban landscapes, supplying essential nutrients, reducing household food expenditures, and generating income for roadside vendors and small-scale processors (Akinyode, 2023; Apeh, Agbugba, & Mdoda, 2023). Studies in Benue State further reveal that households and civil

servants express a willingness to pay for the environmental services provided by trees, highlighting their perceived economic and cultural value (Sambe, Aondona, & Egba, 2021). These findings align with research from Benin City, where urban residents attached high monetary value to trees for their roles in flood control, air purification, and scenic beauty (Arabomen, Chirwa, & Babalola, 2019). Collectively, such evidence underscores the extent to which economic trees function as everyday livelihood assets, bridging ecological adaptation with economic resilience.

Beyond individual and household-level benefits, urban trees also contribute to infrastructural sustainability. Shaded streets and buildings experience reduced material degradation, while tree-lined markets and school compounds provide not only thermal comfort but also aesthetically enhanced environments that foster social interaction (Alfa & Ancha, 2019). These infrastructural co-benefits are rarely quantified in policy discussions but are increasingly acknowledged as vital to sustainable urbanism (Wheeler, 2013). Importantly, they reinforce the argument that economic trees should be viewed not as marginal or decorative but as infrastructural elements of equal importance to roads and drainage networks.

Despite their multiple benefits, significant challenges undermine the systematic integration of economic trees into Nigerian urban planning. Several studies identify weak institutional frameworks, fragmented governance, and the dominance of short-term urban development priorities as critical barriers (Akinbode & Komolafe, 2021; Alfa & Ancha, 2019). Rapid urbanization often results in the displacement of tree cover for housing and road expansion, while government-led greening campaigns suffer from poor maintenance and limited community ownership. Moreover, planning biases frequently privilege exotic ornamental species over indigenous economic trees, overlooking their resilience, cultural familiarity, and livelihood value. These gaps reflect broader critiques in the literature, which caution that while urban forestry is widely promoted, its operationalization in African cities remains uneven and constrained by governance and socio-economic realities (Hodson & Marvin, 2010).

What emerges from this literature is a consensus on the ecological, social, and economic value of urban trees, coupled with a recognition of systemic barriers to their adoption. Yet, there remains a paucity of scholarship that explicitly foregrounds economic trees as nature-based solutions within urban design. While studies document individual benefits such as temperature regulation, income generation, or willingness-to-pay, few adopt a holistic framework that integrates these functions into the broader discourse of climate-resilient urbanism. This gap is particularly evident in Nigerian scholarship, where research often focuses on either forestry or urban planning without adequately bridging the two domains.

By situating economic trees at the intersection of ecological modernization, resilience theory, and sustainable urbanism, this paper addresses this critical gap. It argues that economic trees represent a culturally grounded, low-cost, and multifunctional form of NbS capable of transforming urban vulnerabilities into opportunities for climate adaptation and socio-economic advancement. The empirical focus on Benue State provides a relevant case study, given the state's agricultural base, rapid urbanization, and exposure to climate variability. In doing so, the paper contributes to both local policy debates and international discussions on how Global South cities can operationalize NbS to build resilience while enhancing equity and livability.

4.0 Policy and Theoretical Implications

The reviewed literature and empirical insights converge on the recognition that economic trees offer multifunctional benefits that extend well beyond conventional notions of urban greening. Their ecological services, ranging from carbon sequestration and microclimate regulation to stormwater management, intersect with socio-economic contributions such as food security, income generation, and cultural cohesion. Yet, as the Nigerian and broader African experience demonstrates, these potentials remain underutilized due to governance weaknesses, fragmented planning, and competing land-use priorities (Akinbode & Komolafe, 2021; Alfa & Ancha, 2019). This section distills the policy and theoretical implications of positioning economic trees as nature-based solutions (NbS) for climate-resilient urbanism, with a focus on Benue State, while situating the argument within wider global discourses.

4.1 Policy Implications

First, the integration of economic trees into urban planning frameworks is both urgent and practical. Current Nigerian city master plans largely privilege built infrastructure, roads, markets, and housing, while green infrastructure is treated as optional or cosmetic. Yet international experience demonstrates that NbS can be mainstreamed through zoning laws, building regulations, and urban design standards (Kabisch et al., 2016; UN-Habitat, 2020). For Benue State, embedding economic trees into housing estates, transport corridors, and market layouts would transform them from incidental features to deliberate infrastructural assets. This requires legal mandates that assign urban forestry equal status to drainage and road networks in planning codes.

Second, successful integration hinges on community participation and co-management. Literature from Nigeria consistently shows that households and communities already recognize the economic and cultural value of trees (Arabomen, Chirwa, & Babalola, 2019; Sambe, Aondona, & Egba, 2021). Building on this awareness, participatory models can ensure that urban forestry initiatives are not state-driven campaigns with short lifespans but community-anchored practices with long-term sustainability. In Benue, leveraging ward committees, market associations, and school-based initiatives could institutionalize stewardship, aligning with Ostrom's (1990) principle of collective resource governance.

Third, there is a need to strengthen economic incentives and value chains. Urban forestry policies should not only emphasize planting but also create enabling environments for processing and marketing tree products. For instance, supporting cooperatives in cashew nut processing or shea butter production can generate employment, particularly for women and youth, while reinforcing the linkage between ecological stewardship and livelihood security. Municipal authorities could introduce tax rebates, land-use credits, or recognition schemes for businesses and households that invest in economic tree planting and maintenance. By aligning urban forestry with income generation, policy frameworks can transform trees into engines of resilience and development rather than mere green ornaments.

Fourth, species selection and ecological appropriateness must guide implementation. Many failed greening initiatives in Nigeria reflect a bias for exotic ornamental species poorly adapted to local climates. Prioritizing indigenous economic trees such as mango, neem, moringa, and oil palm would maximize resilience, minimize maintenance costs, and strengthen cultural acceptability. Technical guidelines developed collaboratively with universities, forestry departments, and planning authorities should specify best practices for species diversity, spacing, and long-term care. This aligns with global calls to design NbS that are context-sensitive, ecologically robust, and socially equitable (Elmqvist et al., 2019).

4.2 Theoretical Implications

At the theoretical level, this paper advances three key implications.

First, it deepens the application of ecological modernization in African urban contexts. The theory's emphasis on reconciling economic growth with environmental stewardship is often criticized as overly technocratic (York & Rosa, 2003). Yet, when localized through economic trees, ecological modernization acquires renewed relevance: it demonstrates how low-cost, culturally embedded innovations can simultaneously enhance urban resilience and stimulate livelihoods in Benue State. This challenges the assumption that modernization necessarily requires high-technology solutions.

Second, the analysis reinforces the value of resilience theory in framing urban socio-ecological systems as adaptive and multifunctional. Economic trees exemplify diversity, redundancy, and adaptive capacity three core attributes of resilient systems (Walker et al., 2004). However, the Nigerian context also exposes the limitations of resilience discourse when governance structures are weak, suggesting the need to complement community-based resilience with

stronger institutional frameworks. Thus, the case of Benue illustrates both the possibilities and constraints of operationalizing resilience in developing cities.

Third, the findings extend the discourse on sustainable urbanism by foregrounding economic trees as a distinctive form of green infrastructure that simultaneously addresses ecological, economic, and cultural needs. Sustainable urbanism often risks being abstract or overly idealized (Hodson & Marvin, 2010). By grounding it in the everyday realities of fruit-bearing and medicinal trees, the Benue case demonstrates how sustainability principles can be localized through tangible, familiar practices that resonate with urban residents. This enriches the global debate by offering a model of sustainable urbanism rooted in indigenous ecological knowledge and livelihood practices.

4.3 Bridging Global and Local Discourses

Finally, positioning economic trees as NbS offers a critical bridge between global policy frameworks and local realities. International agendas such as the United Nations Sustainable Development Goals (SDGs), the Paris Agreement, and the IPCC adaptation pathways emphasize NbS as cost-effective tools for climate adaptation. Yet, much of the global discourse is dominated by examples from the Global North. By foregrounding economic trees in Benue State, this paper contributes a Global South perspective that highlights culturally embedded, low-cost, and community-driven approaches to resilience. Such contributions are essential for rebalancing global debates on sustainable urbanism, ensuring that African cities are not passive recipients of imported models but active producers of context-specific knowledge.

5.0 Conclusion and Future Research Directions

This paper has examined the role of economic trees as nature-based solutions for advancing climate-resilient urbanism, with a focus on Benue State, Nigeria. By reframing economic trees as more than ornamental or peripheral greenery, the analysis highlights their multifunctional contributions to environmental regulation, food and income provision, cultural symbolism, and infrastructural support. Integrating these trees into urban design offers a pragmatic, low-cost, and culturally grounded strategy for mitigating climate risks while simultaneously enhancing livelihoods. This dual ecological-economic role distinguishes economic trees from conventional urban forestry, positioning them as critical assets for cities navigating the twin challenges of rapid urbanization and climate change.

Theoretically, the study demonstrates the value of bridging ecological modernization, resilience theory, and sustainable urbanism to interpret the multifunctionality of economic trees. Practically, it underscores the urgency of embedding tree-based strategies into city master plans, aligning local policies with global commitments to nature-based solutions and sustainable development. By foregrounding a Global South perspective, the paper contributes to international debates on urban climate adaptation, challenging the dominance of Euro-American models and offering an African case where resilience is pursued through culturally embedded ecological practices.

Nonetheless, gaps remain that call for further inquiry. Future research should employ quantitative and spatial analyses to measure the long-term ecological and economic impacts of economic trees in urban environments, including carbon sequestration, energy savings, and food system contributions. Comparative studies across African cities could illuminate how governance structures, cultural norms, and land-use pressures shape the adoption of tree-based strategies. Additionally, interdisciplinary research that integrates urban planning, forestry, and public health would enrich understanding of the co-benefits of economic trees, particularly for vulnerable populations.

In conclusion, the integration of economic trees into urban design represents both an immediate adaptation strategy and a long-term vision for sustainable urban futures. For Benue State and similar contexts across the Global South, economic trees provide a pathway to climate resilience that is ecologically effective, socially equitable, and economically viable. Their adoption not only strengthens local adaptive capacity but also broadens the global

repertoire of nature-based solutions, reinforcing the idea that sustainable urbanism must be informed by locally grounded, culturally resonant, and economically inclusive practices.

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Conflicts of Interest

The authors declare that there are no conflicts of interest relevant to this study.

Ethical Approval

This article does not contain any studies involving human participants or animals performed by any of the authors. Ethical approval was therefore not required.

Author Contributions

Tyonum Emmanuel conceived the study, developed the conceptual framework, and led the manuscript writing. Iornumbe Sandra M. contributed to the literature review, data synthesis, and editing. Ameh John E. provided inputs on methodological alignment, policy analysis, and formatting. All authors read and approved the final manuscript.

Data Availability

No primary datasets were generated or analyzed for this study. All data supporting the findings are drawn from published sources cited in the manuscript.

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