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Review Article

Green Roof Adoption in Nigerian Cities: A Review

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Abstract

The high rate of urbanization in Nigerian cities has intensified environmental problems such as urban heat islands and deteriorating air quality. These challenges are further increased by traditional roofing systems, which retains heat and increase runoff of stormwater. Green roof systems, a subset of the broader concept of green infrastructure, presents a viable solution by providing significant microclimate and environmental benefits. In Nigeria, adoption of green roofs is still on the low scale, despite their suitability for tropical climates. The review sets out to examine the current state of green roof adoption in Nigeria by synthesizing fifteen peer-reviewed articles published between 2000 and 2025 and retrieved from Scopus and Google Scholar databases respectively. The findings indicate that there is growing level of academic and professional interest and less practical implementation. Most of the reviewed studies are geographically concentrated in Lagos. Empirical and simulation-based evidence suggests that green roofs are able to lower surface temperatures by 10-25 ℃ and improve indoor comfort by up to 3 ℃. However, obstacles to implementation include cost of high installation, unskilled personnel, shortage of local standards and weak policy guidelines despite their benefits. The study concludes that through proper advocacy and localisation, green roofs could become a key tool of environmental resilience and sustainable cities in Nigeria.

Keywords

Green Roof, Green Infrastructure, Conventional Roof, Nigeria, Adoption

1. Introduction

Rapid urbanization in Nigeria, as in other tropical cities, has increased the pressures on the environment such as urban heat islands (UHI) and flash floods, as well as poor air quality [27, 12]. Concrete slabs and corrugated aluminum roofs further contributes to these problems by absorbing heat and increasing the movement of storm water. Green infrastructure (GI) practices refer to greening ideas that are put in place to reduce the effects of anthropogenic activities in urban places across the world [25, 22, 11]. Among the main characteristics are green roofs, which consist of vegetated layers mounted on the roof tops and provide evidence-based and cost-effective countermeasure that provide various co-benefits such as thermal regulation, mitigation of urban air pollution, storm management, energy savings and enhancement of the biodiversity [3, 4, 13].

Operationally, there are either extensive systems (<20cm depth)- lightweight and low-maintenance with shallow substrates or intensive systems (>20cm depth)- deeper and heavy roofs with a variety of vegetation [9, 8]. Globally, green roof uptake has expanded markedly over the past two decades, driven by policy incentives, climate resilience goals, and growing evidence of their multifunctional performance.

Despite the documented effectiveness of green roofs in climates similar to Nigeria, their uptake remains minimal.

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This limited adoption is frequently attributed to a low awareness of the technology, perceived high installation, culture, lack of expertise, insufficient local guidelines or standards, and policy gaps [6, 23]. Globally, countries in Europe and North America have advanced green roof integration through supportive regulations, subsidies, and demonstration projects. These experiences have provided lessons to be learnt by Nigeria- especially the need for stakeholder awareness programs, pilot programs and policies that should be localized.

The Lagos Green Roof Resilience Project, started by Sustainable Solutions to Green Growth, is a prime example. It aims to address environmental issues and climate change in Lagos, Nigeria. The initiative highlights green roofs as a cutting-edge tactic to reduce air pollution, lessen the impact of the urban heat island, and increase local communities' resilience.

Table 1. *Characteristics and Distribution of Green Roof Studies in Nigeria (2000-2025).*

Category	Sub-category	Papers	%	Examples
Publication Type	Journal Articles	10	66.7%	[1, 16, 20]
	Conference Papers	3	20%	[19, 15, 23]
	These/Academic Reports	2	13.3%	[17, 26]
Methodology Used	Review	3	20%	[1, 14]
	Survey	6	40%	[6, 15]
	Interview	1	6.7%	[5]
	Field Measurement	2	6.7%	[24, 26]
	Simulation/Modelling	2	13.3%	[19, 2]
	Policy/Regulatory Analysis	1	6.7%	[18]
Geographic Focus	Lagos	7	46.7%	[6, 2]
	Southwest (Akure, Ibadan)	3	20%	[19, 1]
	Northern Cities (Zaria, Kaduna)	3	20%	[23, 26]
	National/General	2	13.3%	[5, 18]
Thematic Focus	Benefits/Performance	9	60%	Energy reduction, thermal comfort, air quality
	Barriers to Adoption	8	53.3%	Skills gap, cost, awareness [20]
	Policy and Regulation	4	26.7%	BEEC, NBC, government frameworks
	Cost/Economic Analysis	3	20%	[2]
	Structural/Engineering Issues	3	20%	[24, 26]
Green Roof type Studies	Extensive Systems	8	53.3%	
	Intensive Systems	3	20%	
	Retrofit Green Roofs	4	26.7%	

This review synthesizes the current state of green roof adoption in Nigeria, surveying available literature on benefits, barriers, and opportunities. While most empirical studies cluster around Lagos, broader national data remains sparse. It compares international precedents to highlight pathways for promoting green roof technology within Nigeria's urban development agenda. Similarly, this review helps determine the current status of research on green roof scattered in literature.

2. Methodology

Two major online databases Scopus and Google Scholar were used to perform a literature search. Scopus is also the most reputable source of scholarly work since it provides a broad access to a great variety of high-quality and peer reviewed publications. However, Google Scholar was used as a complementary resource because it indexes a broader spectrum of materials such as conference proceedings, institutional publications, and articles from developing countries - produced by researchers and institutions that may not have means to pay for Scopus subscriptions, yet contribute valuable, context-specific knowledge.

More than 80 items were retrieved through multiple rounds of database searches. The searches process used keywords including green roof, vegetated roof, roof garden, eco roofs, Nigeria, and Adoption. Titles of the retrieved items were first screened for relevance. Following this, the abstracts of selected items were reviewed to assess whether the full papers were relevant and useful to the study.

The inclusion criteria used to determine the relevance of retrieved items were as follows: the study must address the adoption of green roofs within the Nigerian context, be conducted between the years 2000 and 2025, and be situated in one or more Nigerian cities. After applying these criteria, a total of 15 papers were identified and selected (See Table 1). These papers were organized according to their thematic focus on green roof studies in Nigeria. A preliminary examination of the information contained in each paper was undertaken, followed by emergent coding to capture recurring concepts and patterns. Afterward, thematic analysis was used to define the key and minor themes, and content analysis was used to decode the information systematically, to make sure that all the trends, drivers, barriers, and contextual influences on the adoption of green roof in the urban environment of Nigeria were fully understood.

3. Results and Discussion

3.1. Benefits of Green Roof

Reviewed studies shows that green roof has some thermal and microclimatic advantages. Nevertheless, little consideration is given to simulation and field study practiced in Nigeria. [19] simulated the design of retrofit of student housing in a University in Akure, and it was shown that retrofit with green roofs and other environmentally friendly designs would lead to less energy consumption. On the same note, the empirical evidence of [26] depicts the losses of heat and the enhancement of air quality with the introduction of green roofs. Other researchers particularly Zaria reveal that the temperature of the roof surfaces can be reduced by approximately 10-25 ℃ relative to traditional roofs during peak sunshine whereas the temperature in the interior can be lowered by approximately 0.5-3.0 ℃ [24]. Improvement in indoor comfort ranked highest followed by an improvement in air quality from another empirical study [6].

The Nigerian findings align with broader tropical simulations showing 10-13% reductions in total building energy and cooling demand from roof greening, alongside lower air temperatures and solar gains [21].

Despite these advantages, there still exists, a dearth of local research when it comes to longitudinal studies and field based evaluations.

3.2. Barriers of Green Roof Adoption

In Nigeria and in Lagos especially, studies indicate an increase in professional knowledge but minimal practical application. Lack of awareness of fixing, skill gap, unwilling to change, and poor infrastructure are perceived to be barriers to study [15, 20]. Similarly, the concept of green roof remains mostly hidden in the Nigerian building climate as there has been little research done on how to implement green roof in Nigeria [1]. High upfront costs of waterproofing, root barriers, lightweight substrates, and irrigation particularly during the dry season are repeatedly noted as primary deterrents. Green roof installation was pegged at #25,000 per square metre against #8,000 for concrete roofs [2]. With reference to existing buildings, a significant portion of existing buildings lack reserve capacity for even lightweight extensive systems without strengthening [2].

3.3. Policy Frameworks for Green Roofs

Nigeria lacks explicit, widely enforced green roof incentives in core building regulations pointing to policy fragmentation and limited institutional frameworks for broader green construction [5]. Although steps are made towards energy-efficient buildings through instruments such as the Building Energy Efficiency Code (BEEC) and evolving references within the Nigerian Building Code (NBC). However, there are no current policy-based non-financial incentives for green roof implementation, such as density bonuses or expedited approvals [16, 18, 7]. This limits significantly, the attractiveness of voluntary adoption.

3.4. Research Gaps

Local expertise and procedures still have a lot of observed gaps. There are few engineering guidelines for retrofits, cost analysis of locally sourced materials, field-based performance monitoring, and native vegetation maintenance procedures (Jamei et al, 2023; Ogunnaike et al, 2025). In order to ensure evidence-based decision making in urban planning and to scale the adoption of green roofs, these gaps need to be filled.

Table 2. Key research gaps in Nigerian Cities.

s/n		Status	
		Available	Rare /Not available
1	Measured Field Data	Simulations, global analogues, perception surveys	Long-term monitoring (surface/air temperatures, runoff volumes, biodiversity)
2	Economics for local supply chain [6]	Transparent cost for domestically sourced membranes, substrates, and plants	Comparison with other roof type
3	Policy experiments	Federal BEEC	Rigorous evaluation of incentives (fees rebates, public procurement)
4	Retrofit engineering guidance [14]		Practical; structural assessment protocols for typical Nigerian roof slabs and lightweight assemblies
5	Planting palettes and maintenance [10]		Comparative trials of more native grasses

3.5. The Path to Green Roof Adoption in Nigerian Cities

Reviewed studies highlighted the many benefits green roof offers. Awareness among professionals is growing but the actual installation and studies remain largely limited partly because the enabling environment, codes, incentives, supply chains, and retrofit engineering still lags. In addressing these gaps (see Table 2), a pragmatic way for Nigerian cities could be to pilot extensive green roofs on public buildings, transport shelters to de-risk delivery. Also, there could be a need to embed non-financial incentives and clear specifications in development control, and lastly, commission measured monitoring to localize performance claims on energy, stormwater and heat exposure. These actions are capable of moving green roofs from a state of being largely unnoticed to a mainstream component in the country's green infrastructure framework if effectively implemented [1].

4. Conclusion

Scholarly review reveals that while the concept and advantages of green roofs are increasingly recognized within Nigerian cities, their practical adoption remain largely limited. This paper contributes to a growing body of knowledge on sustainable urbanism by revealing the current state of a specific feature of green infrastructure in Nigeria. Most studies and pilot efforts are concentrated in Lagos, with minimal implementation across other Nigerian cities. Both empirical and simulation-based evidences demonstrate consistently, the potential of green roofs to mitigate heat stress, improve indoor comfort, enhance air quality, energy efficiency and stormwater management.

Nigeria is in a very critical juncture as the shift to sustainable urban environment requires innovative solutions. Green roofs can offer a promising and diverse approach towards dealing with the environmental pressures in the face of intense urbanization and hence improving the resilience of cities and environmental quality in Nigeria.

This paper's synthesis of Nigerian green roof literature is one of its main contributions. The study closes a significant knowledge gap about the adoption of green roofs in Nigerian cities by methodically reviewing studies published between 2000 and 2025. It also creates a baseline for further empirical and policy-focused research. Future research should focus on field-based performance monitoring, cost-benefit analysis, and policy-driven implementation strategies to accelerate the integration of green roofs into Nigeria's urban sustainability framework.

Abbreviations

BEEC Building Energy Efficiency Code
NBC Nigerian Building Code

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Author Contributions

Olusoga Olawale Oreoluwa is the sole author. The author read and approved the final manuscript.

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Conflicts of Interest

The author declares no conflicts of interest.

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Biography

Olusoga Olawale Oreoluwa is a Nigerian architect, academic, and researcher specializing in housing, urban design, and green infrastructure. A Senior Lecturer in the Department of Architecture at the Federal University of Technology, Akure (FUTA), he focuses on sustainable urban development through teaching and research. His work examines housing policy, nature-based solutions, vertical greening in low-income areas, cooperative housing delivery, and neighborhood change in Nigerian cities, with an emphasis on climate resilience. Dr. Oreoluwa is deeply engaged in community-based projects, particularly in informal and coastal settlements, including climate adaptation initiatives in Ondo State. He has also contributed to international projects in Uganda and South Africa and currently participates in a Lagos-based forum addressing heat, health, and housing in disadvantaged communities.

Research Field

Olusoga Olawale Oreoluwa: Housing, Green Infrastructure, Urban Sustainability.