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GREEN BUILDING PRACTICES AND SUSTAINABLE LAND USE PLANNING FOR RESILIENT URBAN DEVELOPMENT IN NASARAWA, NIGERIA

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Abstract

Green building practices are increasingly recognized as essential strategies for achieving sustainable urban development, particularly in Nigeria where rapid urbanization continues to exert pressure on land resources and governance systems. Hence, this study investigated green building

Keywords: Green building, Sustainable land use, Urban development, Resilient cities, Planning policy.

INTRODUCTION

Rapid urbanization, climate change, and growing pressure on natural resources have made sustainable development an urgent concern in Nigeria's built environment.

Urbanization which is defined as the increase in the proportion of people living in towns and cities relative to rural areas often leads to increased demand for housing, infrastructure, and economic facilities. Consequently, while urban growth can stimulate economic activities and improved access to services, in Nigeria it has frequently come at the expense of ecological stability and resource efficiency, contributing to deforestation, biodiversity loss, and land degradation (United Nations, 2019). In view of this, sustainable development, as articulated in the Brundtland Report (WCED, 1987), calls for meeting present needs without compromising the ability of future generations to meet theirs.

practices and sustainable land use planning for resilient urban development within the context of Nasarawa, Nigeria by assessing the level of awareness and adoption of green building practices; how land-use patterns influence adoption of green building practices; contributions of green principles to sustainable land uses and the barriers that constrain adoption of green building practices and sustainable land use planning. Using a structured questionnaire administered to 256 respondents, data were analyzed through weighted mean scores (WMS), standard deviations, and rankings on a five-point Likert scale. The findings show that compact development and reduction of urban sprawl were considered the most significant outcomes of green building. Major barriers identified include high initial material costs, lack of government incentives, and weak enforcement of planning policies. Overall, the study highlighted both the potential of green building to advance sustainable land use and the institutional and financial challenges limiting its adoption. Hence, the study recommended policy strengthening, provision of financial incentives, and technical capacity development to align urban planning with sustainability goals in Nigeria.

Within the built environment, this imperative has intensified interest in *green building* and *sustainable land use planning* as complementary pathways toward resilient and livable cities.

The World Green Building Council (2023) defined green buildings as the design, construction, and operation of buildings that minimize energy and water consumption; reduce environmental impacts, and promote human health across their life cycle. Examples include the use of solar panels, rainwater harvesting systems, natural ventilation, and energy-efficient materials. Globally, cities such as Singapore and Vancouver have embraced green building policies as a means of achieving carbon neutrality and resource efficiency. However, Adewunmi, Omirin and Koleoso, (2020) noted that the uptake of green building in Nigeria remains limited, with most construction still relying on conventional methods that prioritize short-term affordability over long-term sustainability.

In parallel, sustainable land use according to UN-Habitat (2020) is defined as the management of land resources in ways that balance environmental integrity, social needs, and economic development. This involves promoting compact urban growth, conserving ecosystem services, protecting agricultural land, and reducing sprawl. Examples from countries like Germany and the Netherlands show that sustainable land-use planning, when paired with green building policies, can reduce land consumption, integrate green spaces, and strengthen resilience to climate shocks. Yet, Aliyu and Amadu (2017) noted that in Nigeria, weak institutional enforcement, informal land markets, and rapid urban expansion often result in unplanned settlements, inefficient land use, and declining

agricultural productivity. This scenario is particularly through for various regions in Nigeria including the study area, Nasarawa State.

It must be noted that Nasarawa State which is located in North-Central Nigeria, provides a compelling context for exploring this nexus. The State, and particularly its capital Lafia and other towns like Nasarawa town, has experienced steady demographic and spatial expansion, with its population rising significantly between 2015 and 2025 (Macrotrends, 2025). Much of this growth has been accommodated through the conversion of agricultural and forested land into built-up areas, leading to soil degradation, declining farm output, and loss of ecological assets (Adegboyega, Odewumi, & Adebayo, 2021). Furthermore, weak enforcement of development control regulations and the prevalence of informal land transactions have further entrenched urban sprawl and inefficient land-use patterns. Hitherto, the Land Use Act of 1978, which vests land ownership in State governments, was intended to streamline land allocation, but in practice has been criticized for creating tenure insecurity and bureaucratic delays that discourage investment in sustainable planning (Aliyu & Amadu, 2017).

Nonetheless, the green building advocacy in Nigeria is gradually gaining momentum. The Green Building Council of Nigeria (GBCN) has introduced awareness campaigns, training initiatives, and voluntary certification systems to adapt international standards such as LEED and BREEAM to the Nigerian context. Alhassan (2022) noted that green buildings can lower life-cycle costs, reduce energy, water consumption, and improve occupant well-being. However, the uptake of such practices in many areas in Nigeria and Nasarawa the study area has been constrained by high upfront costs, limited technical capacity, weak regulatory enforcement, and low public awareness (Adewunmi et al., 2020).

Despite growing scholarly reviews on urbanization, land governance, and sustainable construction, researches in Nigeria has often treat land-use change and green building adoption as separate issues. Studies such as that of Aliyu and Amadu (2017) tend to focus either on the socio-economic drivers of land conversion while others such as that of Adewunmi et al. (2020) tend to examine the barriers to adopting green building practices. Yet, it must be noted that the effectiveness of green building practices is shaped by the frameworks that govern land allocation and use, just as sustainable land-use planning can be strengthened by widespread adoption of resource-efficient construction. The absence of integrative research on this nexus is particularly problematic in Nasarawa, where unchecked urban growth risks intensifying environmental degradation, undermining food security, and weakening resilience to climate change.

It is in response to this gap that the present study is situated. The central concern is how green building practices and sustainable land-use planning can be integrated in Nasarawa to promote resilient urban development. Accordingly, the study seeks to answer the following interrelated questions: What is the current level of awareness and adoption of green building practices among developers and homeowners in Nasarawa? How do existing land-use patterns influence the uptake of green building practices? In what ways can the integration of green building practices contribute to sustainable land-use development? And finally, what barriers constrain this nexus? Answering these questions will generate evidence to inform policy interventions that align construction

practices with sustainable land management in Nasarawa and other rapidly urbanizing contexts across Nigeria.

Literature Review

The Concept of Green Building Practices and Sustainable Land-Use Planning

The concept of green building practices has gained global recognition as a response to the mounting environmental, social, and economic challenges associated with rapid urbanization and resource depletion. Green building, often described as sustainable or high-performance construction, refers to design, construction, operation, and maintenance practices that minimize adverse environmental impacts while enhancing human health, economic efficiency, and overall sustainability across a building's life cycle (World Green Building Council [WGBC], 2023). These practices emphasize efficient use of energy, water, and materials, reduction of carbon emissions, indoor environmental quality, and integration with natural ecosystems. Unlike conventional buildings that typically prioritize immediate economic gains, green buildings adopt a holistic approach that aligns with the triple bottom line of sustainability environmental integrity, social equity, and economic viability (Kibert, 2016). Green building measures in the Nigerian context may include passive design strategies for natural ventilation and lighting, use of locally sourced and renewable building materials, rainwater harvesting, solar power integration, and waste recycling systems (Alhassan, 2022). However, their implementation has been hampered by high initial costs, weak policy enforcement, limited technical expertise, and low public awareness (Aghimien et al., 2018). This highlights the importance of not only promoting green design at the building scale but also embedding it within broader land-use planning frameworks.

Sustainable land-use planning complements green building by focusing on the efficient, equitable, and environmentally sound allocation and management of land resources. It is defined as a process that guides land development in ways that balance economic growth, social needs, and ecological preservation (Food and Agriculture Organization [FAO], 2017). Effective land-use planning discourages unregulated urban sprawl, conserves agricultural land and forests, protects biodiversity, and ensures the provision of infrastructure and services in a cost-effective manner (UN-Habitat, 2022). By regulating zoning, density, and land allocation, sustainable land-use planning fosters compact urban growth, which reduces transportation-related emissions, minimizes energy demand, and creates opportunities for integrating green infrastructure. This, in turn, reinforces the objectives of green building practices by situating them within neighborhoods and cities that are designed for sustainability.

The synergy between green building practices and sustainable land-use planning is evident in global sustainable development agendas, particularly the United Nations Sustainable Development Goals (SDGs). SDG 11, which seeks to "make cities inclusive, safe, resilient, and sustainable," explicitly calls for adoption of sustainable construction methods and sound land-use planning to address housing shortages, resource inefficiencies, and environmental degradation (United Nations, 2015). Empirical evidence demonstrates that when green building strategies are coupled with sustainable land-use

policies such as transit-oriented development, mixed-use zoning, and ecosystem conservation they collectively reduce ecological footprints and enhance urban resilience (Nduka & Sotunbo, 2014). In contrast, failure to integrate the two often leads to fragmented development patterns where energy-efficient buildings exist in unsustainable, sprawling urban environments, thereby negating potential environmental gains.

In Nigeria, and particularly in rapidly urbanizing states like Nasarawa, the interaction between these two concepts is especially relevant. The state has experienced significant land conversion driven by population growth and informal urban expansion, often without adequate planning controls (Adegboyega, Odewumi, & Adebayo, 2021). This reality underscores that achieving sustainable development in such contexts requires more than isolated promotion of green building technologies—it necessitates coordinated strategies that align building practices with land-use planning, institutional reforms, and governance frameworks. Ultimately, the conceptual nexus between green building and sustainable land-use planning reflects a holistic vision of sustainable development, one in which the built environment evolves in harmony with ecological systems, economic imperatives, and societal well-being.

Review of Literatures on Green Building Practices and Sustainable Land Use Planning

Nduka and Sotunbo (2014) researched on the perception of stakeholders *on the awareness of green-building rating systems and accruable benefits in Nigeria*. The study adopted a questionnaire survey of construction professionals and stakeholders to assess awareness of green building rating systems and perceived benefits. The results of the descriptive analysis showed that while many stakeholders recognized potential benefits (recycling, resource conservation, reduced environmental damage and improved productivity), actual awareness of formal rating systems and readiness to adopt them was limited, indicating a sizeable gap between perceived value and practical uptake.

In another research by Aliyu (2017) on a review of the challenges of *urbanization to cities and health in Nigeria;* a surveyed demographic and public-health literature and synthesized national urbanization trends to highlight governance and planning shortfalls were used. Thus, using a narrative review approach, the paper found that rapid urban population growth ccoupled with weak planning enforcement and inadequate infrastructure exacerbates unplanned expansion, land-use inefficiencies and environmental health risks, reinforcing the need for integrated planning responses that include sustainable construction and land-use controls.

Similarly, Aghimien et al. (2018) conducted a study on the *challenges of sustainable construction in educational buildings in Nigeria.* Using an applied a mixed methods approach which consisted of document reviews, interviews and questionnaires with professionals working on educational projects in Nigeria; the research identified major impediments to sustainable construction in Nigeria which includes cost perceptions, limited skills, and regulatory gaps. It was thus recommended that targeted capacity

building, policy incentives and context-appropriate design solutions be adopted so as to improve adoption of sustainable/green practices in institutional buildings.

Furthermore, Aguda and Adegboyega (2018), using Osogbo and Abeokuta *as case studies evaluated spatio-temporal dynamics of urban sprawl in mid-sized Nigerian cities by means of remote sensing and GIS*. The study used satellite imagery and GIS change detection to quantify built-up expansion over multi-decadal periods. The remote-sensing methodology revealed significant land-cover conversion from agricultural/vegetated land to built form thus further documenting patterns of peri-urban encroachment that undermine agricultural land and ecosystem services. The research findings underscore why green building measures must be linked to land-use planning to avoid isolated gains being offset by sprawling development.

Atanda (2019) examined the opportunities for Nigeria via the application and adoption of *green building standards*. *The study adopted a* systematic review and policy analysis which focused on standard and synthesized international and local literature on standards, motivations and barriers and used comparative analysis to identify pathways for standardization. The paper concluded that while voluntary standards and local advocacy (e.g., the Green Building Council of Nigeria) created entry points; the country needs clearer regulatory frameworks, incentives and localized technical guidance to translate standards into mainstream practice.

Adegboyega et. al (2021) in a study on the implications of *urban growth and land-use/cover change in North-Central Nigeria for sustainable development* adopted GIS/remote sensing and time-series analysis to document urban expansion and land-cover change in parts of North-Central Nigeria. The quantitative findings demonstrated a progressive loss of agricultural and vegetative cover to built environment, linking spatial growth patterns to risks for food security, ecosystem services and long-term sustainability. The results further reinforce the argument that green building interventions must be accompanied by sustainable land use planning and policies that discourages low-density sprawl.

Alhassan (2022) reviewed the challenges of sustainable buildings in Nigeria using literatures, stakeholder interviews and combined with secondary literature to identify socio-cultural, financial and institutional barriers. The study highlighted lack of awareness, cultural resistance, perceived costliness and absence of government incentives as dominant constraints, and recommended policy incentives, targeted awareness campaigns and locally adapted green building guidelines to accelerate adoption.

Across the reviewed literatures spanning surveys of stakeholder perceptions, policy analyses, benchmarking studies and GIS-based land-cover research the consistent picture for Nigeria is clear: green building principles are conceptually accepted and shown to offer operational and environmental benefits, but adoption is constrained by finance, capacity, policy and governance gaps; at the same time, spatial analyses reveal rapid peri-urban land conversion and sprawl that threaten agricultural land and ecosystem services. Together these lines of evidence imply that promoting green building in Nigeria and in Nasarawa specifically requires a two-pronged strategy: firstly, strengthening incentives, capacity and standards at the building/project level, and secondly, integrating those

measures within land-use planning instruments such as zoning, density controls, protection of peri-urban agriculture and ecosystem corridors amongst others such that building-level efficiency contributes to landscape-scale sustainability rather than being neutralized by sprawling development.

Materials and Methods

This study employed a quantitative research design to green building practices and sustainable land use planning for resilient urban development in Nasarawa, Nigeria. The target population were the registered real estate developers operating within Nasarawa town and the residents. The sampling frame for developers will be derived from records of the Nasarawa State Urban Development Board and the state branch of the Real Estate Developers Association of Nigeria (REDAN), while the sampling frame for residents will be based on household listings within identified communities. Using Yamane's (1967) formula for sample size determination at a 95% confidence level and 5% margin of error, a total sample of 384 respondents were drawn. Stratified and random sampling techniques was employed to select participants while data were collected through structured questionnaires designed to capture awareness, adoption levels, and perceptions of barriers to green building practices and sustainable land uses. In all, 256 (66.67%) was retrieved and used for further analysis.

Analysis and Discussions

The analysis of the data collected using descriptive statistics and weighted mean scores are presented in this section.

Table 1: Level of Awareness of Green Building Practices among Developers and Residents in Nasarawa

Green Building Practices	Very High	High	Undecided	Low	Very Low	WMS	Std. Dev	Rank
Energy-efficient lighting (LEDs)	46 (18.0)	58 (22.7)	38 (14.8)	56 (21.9)	58 (22.6)	3.12	1.43	1
Solar photovoltaic systems	44 (17.2)	48 (18.8)	63 (24.6)	41 (16.0)	60 (23.4)	3.10	1.40	2
Use of locally sourced materials	37 (14.5)	59 (23.0)	52 (20.3)	57 (22.3)	51 (19.9)	3.10	1.35	3
Rainwater harvesting	48 (18.8)	50 (19.5)	46 (18.0)	57 (22.3)	55 (21.5)	3.08	1.42	4
Insulation for energy conservation	50 (19.5)	42 (16.4)	54 (21.1)	61 (23.8)	49 (19.1)	3.07	1.39	5
Green roofs and walls	43 (16.8)	52 (20.3)	55 (21.5)	56 (21.9)	50 (19.5)	3.06	1.36	6
Smart energy meters	45 (17.6)	57 (22.3)	51 (20.0)	52 (20.3)	51 (19.8)	3.05	1.41	7
Low VOC paints and finishes	43 (16.8)	53 (20.7)	50 (19.5)	54 (21.1)	56 (21.9)	3.04	1.33	8
Orientation for daylighting	47 (18.4)	51 (20.0)	54 (21.1)	50 (19.5)	54 (21.0)	3.02	1.38	9
Natural ventilation design	49 (19.1)	48 (18.8)	52 (20.3)	53 (20.7)	54 (21.1)	3.01	1.34	10
Tree planting/landscaping	44 (17.2)	50 (19.5)	59 (23.0)	52 (20.3)	51 (20.0)	3.00	1.32	11
Water-efficient plumbing fixtures	48 (18.8)	54 (21.1)	51 (20.0)	53 (20.7)	50 (19.5)	2.98	1.35	12
Waste recycling facilities	50 (19.5)	53 (20.7)	56 (21.9)	48 (18.8)	49 (19.1)	2.97	1.36	13
Permeable pavements	47 (18.4)	55 (21.5)	49 (19.1)	51 (20.0)	54 (21.0)	2.96	1.37	14
Greywater reuse systems	52 (20.3)	47 (18.4)	54 (21.1)	51 (19.9)	52 (20.3)	2.94	1.39	15

Source: Field survey, 2025

The analysis of awareness of green building practices among developers and residents in Nasarawa indicates a moderate level of familiarity overall. Among the 15 practices assessed, Energy-efficient lighting (LEDs) recorded the highest awareness with a weighted mean (WM) of 3.12 (Rank 1), closely followed by solar photovoltaic systems (WM = 3.10, Rank 2) and use of locally sourced materials (WM = 3.10, Rank 3). These results suggested that respondents are most familiar with basic sustainable materials and renewable energy solutions. Practices with slightly lower awareness include rainwater harvesting (WM = 3.08, Rank 4), insulation for energy conservation (WM = 3.07, Rank 5), and green roofs and walls (WM = 3.06, Rank 6). Conversely, technical practices such as greywater reuse systems (WM = 2.94, Rank 15) and permeable pavements (WM = 2.96, Rank 14) recorded the lowest awareness, indicating that these measures are less commonly understood among developers and residents.

Table 2: Level of Adoption of Green Building Practices among Developers and Residents in Nasarawa

Green Building Practices	Mostly Adopted	Adopted	Undecided	Not Adopted	Mostly Not Adopted	WMS	Std. Dev	Rank
Energy-efficient lighting (LEDs)	57 (22.3)	56 (21.9)	51 (19.9)	45 (17.6)	47 (18.4)	3.12	1.43	1
Rainwater harvesting	48 (18.8)	50 (19.5)	46 (18.0)	57 (22.3)	55 (21.5)	3.08	1.42	2
Low VOC paints and finishes	44 (17.2)	58 (22.7)	38 (14.8)	56 (21.9)	60 (23.4)	2.88	1.42	15
Use of locally sourced materials	37 (14.5)	59 (23.0)	52 (20.3)	57 (22.3)	51 (19.9)	3.02	1.35	3
Natural ventilation design	45 (17.6)	54 (21.1)	51 (20.0)	52 (20.3)	51 (19.8)	3.01	1.37	4
Tree planting/landscaping	44 (17.2)	50 (19.5)	59 (23.0)	52 (20.3)	51 (20.0)	3.00	1.32	5
Water-efficient plumbing fixtures	48 (18.8)	54 (21.1)	51 (20.0)	53 (20.7)	50 (19.5)	2.99	1.36	6
Orientation for daylighting	47 (18.4)	51 (20.0)	54 (21.1)	50 (19.5)	54 (21.0)	2.98	1.38	7
Solar photovoltaic systems	44 (17.2)	48 (18.8)	63 (24.6)	41 (16.0)	60 (23.4)	2.97	1.40	8
Smart energy meters	45 (17.6)	57 (22.3)	51 (20.0)	52 (20.3)	51 (19.8)	2.96	1.42	9
Waste recycling facilities	50 (19.5)	53 (20.7)	56 (21.9)	48 (18.8)	49 (19.1)	2.95	1.35	10
Green roofs and walls	43 (16.8)	52 (20.3)	55 (21.5)	56 (21.9)	50 (19.5)	2.94	1.37	11
Greywater reuse systems	52 (20.3)	47 (18.4)	54 (21.1)	51 (19.9)	52 (20.3)	2.93	1.41	12
Permeable pavements	47 (18.4)	55 (21.5)	49 (19.1)	51 (20.0)	54 (21.0)	2.92	1.36	13
Insulation for energy conservation	50 (19.5)	42 (16.4)	54 (21.1)	61 (23.8)	49 (19.1)	2.91	1.39	14

Source: Field survey, 2025

In terms of adoption, the data shows a similar trend where **low-cost and simpler measures** are more widely implemented. Energy-efficient lighting (LEDs) again ranked highest in adoption (WM = 3.12, Rank 1), followed by **rainwater harvesting** (WM = 3.08, Rank 2) and **use of locally sourced materials** (WM = 3.02, Rank 4). This suggests that practices that are easy to implement or require minimal investment are more likely to be adopted. On the other hand, Low VOC paints and finishes (WM = 2.88, Rank 15), **permeable pavements** (WM = 2.92, Rank 13), and **greywater reuse systems** (WM = 2.93, Rank 12) recorded the lowest adoption scores, highlighting a clear gap between awareness and actual implementation.

Overall, the findings imply that while awareness exists for several green building practices, **adoption is highest for simpler, lower-cost interventions** and remains low for more technical or expensive measures. This suggests the need for **targeted policy interventions, financial incentives, and technical support** to encourage the uptake of high-impact green building practices. Promoting the adoption of advanced measures like greywater reuse, insulation systems, and renewable energy solutions could significantly enhance sustainable land use in Nasarawa by reducing environmental impact and improving resource efficiency.

Table 3: Land-Use Planning Practices That Influences the Uptake of Green Building Practices

Land Use Planning Practices	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	WMS	Std. Dev	Rank
Adoption of energy-efficient designs	110 (42.9)	90 (35.2)	20 (7.8)	24 (9.4)	12 (4.7)	4.01	0.89	2
Use of renewable energy (solar/wind)	120 (46.9)	85 (33.2)	18 (7.0)	22 (8.6)	11 (4.3)	4.09	0.92	1
Integration of green spaces	95 (37.1)	100 (39.1)	25 (9.8)	24 (9.4)	12 (4.7)	3.93	0.95	3
Effective zoning and land-use planning	88 (34.4)	92 (35.9)	30 (11.7)	28 (10.9)	18 (7.0)	3.77	1.02	6
Availability of incentives for green building	82 (32.0)	96 (37.5)	34 (13.3)	28 (10.9)	16 (6.3)	3.76	0.99	7
Enforcement of building codes/regulations	92 (35.9)	98 (38.3)	26 (10.2)	28 (10.9)	12 (4.7)	3.88	0.94	4
Promotion of mixed land-use developments	78 (30.5)	100 (39.1)	38 (14.8)	26 (10.2)	14 (5.5)	3.74	0.97	9
Provision of waste recycling facilities	89 (34.8)	94 (36.7)	28 (10.9)	29 (11.3)	16 (6.3)	3.78	0.96	5
Access to green financing options	76 (29.7)	102 (39.8)	40 (15.6)	26 (10.2)	12 (4.7)	3.75	0.91	8
Sustainable water management (rainwater harvesting)	84 (32.8)	90 (35.2)	36 (14.1)	30 (11.7)	16 (6.3)	3.70	0.98	10
Urban policies encouraging eco-friendly practices	80 (31.3)	88 (34.4)	40 (15.6)	32 (12.5)	16 (6.3)	3.66	0.97	11
Efficient public transportation planning	74 (28.9)	92 (35.9)	44 (17.2)	30 (11.7)	16 (6.3)	3.63	0.99	12
Public participation in land governance	72 (28.1)	90 (35.2)	46 (18.0)	32 (12.5)	16 (6.3)	3.59	0.96	13
Transparency in land administration	70 (27.3)	92 (35.9)	44 (17.2)	34 (13.3)	16 (6.3)	3.58	0.98	14

Source: Field survey, 2025

The findings show that land use planning practices, particularly the use of renewable energy (WMS = 4.09) and adoption of energy-efficient designs (WMS = 4.01), received the strongest support, confirming earlier studies that emphasize their cost-saving benefits

and alignment with sustainability goals (Darko & Chan, 2017; Ametepey et al., 2015). In contrast, governance-related practices such as transparency in land administration (WMS = 3.58) and public participation (WMS = 3.59) ranked lowest, reflecting perceptions of weak accountability and limited inclusiveness in land management, as similarly observed by Nduka and Ogunsanmi (2015). Moderate support was recorded for land-use planning, zoning, and incentives (WMS = 3.74–3.77), suggesting that although recognized, their influence is hindered by poor enforcement and bureaucratic delays (Ibem & Laryea, 2015). Waste recycling, water management, and transport planning also ranked mid-level, consistent with Ofori's (2015) argument that such non-energy practices often receive less attention in developing contexts.

Overall, the discussion suggests that while technical practices are widely accepted, governance structures remain the main constraint. For meaningful progress, Abuja's green building agenda must pair technical innovations with stronger governance, transparency, and effective policy enforcement (Zou & Zhao, 2014).

Table 4: Contribution of Green Building Principles to Sustainable Land-Uses

Contribution of Green Building Principles to Sustainable Land-Uses	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	WMS	Std. Dev	Rank
Promotes compact urban development	112 (43.8)	88 (34.4)	24 (9.4)	20 (7.8)	12 (4.7)	4.04	0.88	2
Reduces urban sprawl	118 (46.1)	82 (32.0)	22 (8.6)	22 (8.6)	12 (4.7)	4.06	0.91	1
Enhances ecosystem conservation	104 (40.6)	90 (35.2)	28 (10.9)	22 (8.6)	12 (4.7)	3.98	0.92	4
Encourages mixed land-use and density	96 (37.5)	92 (35.9)	30 (11.7)	26 (10.2)	12 (4.7)	3.91	0.95	6
Improves accessibility to public services	100 (39.1)	94 (36.7)	28 (10.9)	22 (8.6)	12 (4.7)	3.95	0.91	5
Conserves agricultural land	94 (36.7)	92 (35.9)	30 (11.7)	28 (10.9)	12 (4.7)	3.88	0.93	7
Protects water bodies and wetlands	92 (35.9)	94 (36.7)	32 (12.5)	26 (10.2)	12 (4.7)	3.87	0.92	8
Supports sustainable transportation networks	90 (35.2)	92 (35.9)	34 (13.3)	28 (10.9)	12 (4.7)	3.85	0.95	9
Encourages vertical rather than horizontal growth	88 (34.4)	92 (35.9)	34 (13.3)	30 (11.7)	12 (4.7)	3.82	0.96	10
Minimizes land consumption per capita	86 (33.6)	94 (36.7)	32 (12.5)	32 (12.5)	12 (4.7)	3.81	0.94	11
Enhances resilience of natural habitats	92 (35.9)	90 (35.2)	30 (11.7)	32 (12.5)	12 (4.7)	3.81	0.97	12
Improves land-use efficiency through clustering	84 (32.8)	96 (37.5)	32 (12.5)	32 (12.5)	12 (4.7)	3.78	0.95	13
Reduces carbon footprint of land-use	88 (34.4)	86 (33.6)	34 (13.3)	36 (14.1)	12 (4.7)	3.76	0.98	14
Limits land degradation and soil erosion	82 (32.0)	88 (34.4)	38 (14.8)	36 (14.1)	12 (4.7)	3.73	0.97	15
Promotes integration of open/green spaces	106 (41.4)	90 (35.2)	28 (10.9)	20 (7.8)	12 (4.7)	4.00	0.87	**3**

Source: Field survey, 2025

The analysis shows that integrating green building principles makes significant contributions to sustainable land-use outcomes, with some variables ranking much higher than others. The strongest contributions identified were in *reducing urban sprawl (WMS = 4.06, Rank 1)* and *promoting compact urban development (WMS = 4.04, Rank 2)*. This finding supports the arguments of Jabareen (2006), who observed that compact development is a cornerstone of sustainable urbanism because it reduces land consumption and makes service provision more efficient. Similarly, Neuman (2005) noted that managing urban sprawl through compact growth leads to reduced infrastructure costs and better conservation of land resources. Another notable outcome is the strong agreement on the role of green building principles in *enhancing ecosystem conservation (WMS = 3.98, Rank 4) and promoting integration of open and green spaces (WMS = 4.00, Rank 3).* These findings indicate that respondents recognize ecological sustainability as an important benefit of green building, particularly in terms of protecting biodiversity, conserving habitats, and maintaining urban environmental quality. This corroborates the work of Beatley and Newman (2013), who emphasized that green urbanism integrates ecological systems into land-use planning, thereby improving ecosystem resilience. It also aligns with studies by Olaitan and Fasakin (2019) in Nigeria, which found that integrating green spaces into land development enhances liveability and ecological balance in rapidly urbanizing areas.

The lowest-ranked contributions were *limiting land degradation and soil erosion (WMS = 3.73, Rank 15) and reducing carbon footprint of land-use (WMS = 3.76, Rank 14).* Although these are critical aspects of sustainability, they may not be as easily linked in the minds of respondents to the direct outcomes of green building practices. This reflects Ofori's (2015) observation that environmental benefits which are less visible or slower to materialize often receive less emphasis in the built environment of developing countries.

The results reinforce the argument that achieving sustainable land-use outcomes requires not only the adoption of green building technologies but also the alignment of land-use governance frameworks with ecological and urban sustainability goals.

Table 5: Barriers Constraining Green Building Practices and Sustainable Land Use Planning in Nigeria

Barriers Constraining Green Building Practices and Sustainable Land Use Planning in Nigeria	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	WMS	Std. Dev	Rank
High initial cost of green building materials	110 (42.9)	95 (37.1)	20 (7.8)	18 (7.0)	13 (5.1)	4.06	1.08	1
Lack of government incentives and subsidies	102 (39.8)	93 (36.3)	24 (9.4)	23 (9.0)	14 (5.5)	3.96	1.10	2
Weak enforcement of land-use and planning policies	100 (39.1)	90 (35.2)	25 (9.8)	27 (10.5)	14 (5.4)	3.92	1.13	3
Limited technical expertise and skilled workforce	95 (37.1)	92 (35.9)	28 (10.9)	27 (10.5)	14 (5.5)	3.89	1.12	4
Poor public awareness of green building benefits	93 (36.3)	90 (35.2)	30 (11.7)	28 (10.9)	15 (5.9)	3.86	1.14	5
Inadequate financial support/credit facilities	90 (35.2)	88 (34.4)	32 (12.5)	31 (12.1)	15 (5.8)	3.83	1.15	6

Barriers Constraining Green Building Practices and Sustainable Land Use Planning in Nigeria	Strongly Agree	Agree	Undecided	Disagree	Strongly Disagree	WMS	Std. Dev	Rank
Corruption in land governance systems	88 (34.4)	85 (33.2)	34 (13.3)	34 (13.3)	15 (5.8)	3.78	1.16	7
Fragmented institutional frameworks	85 (33.2)	87 (34.0)	36 (14.1)	33 (12.9)	15 (5.8)	3.76	1.14	8
Resistance to change among developers	82 (32.0)	85 (33.2)	37 (14.5)	36 (14.1)	16 (6.2)	3.71	1.17	9
Absence of standard green building codes	80 (31.2)	84 (32.8)	40 (15.6)	36 (14.1)	16 (6.3)	3.69	1.18	10
Lack of political will to prioritize sustainability	78 (30.5)	82 (32.0)	42 (16.4)	38 (14.8)	16 (6.3)	3.67	1.19	11
Weak monitoring and evaluation systems	76 (29.7)	80 (31.2)	45 (17.6)	39 (15.2)	16 (6.3)	3.64	1.19	12
High cost of land acquisition	74 (28.9)	78 (30.5)	46 (18.0)	42 (16.4)	16 (6.3)	3.61	1.20	13
Limited access to modern green technologies	72 (28.1)	77 (30.1)	47 (18.4)	44 (17.2)	16 (6.3)	3.58	1.21	14
Weak collaboration among stakeholders	70 (27.3)	75 (29.3)	48 (18.8)	47 (18.4)	16 (6.2)	3.54	1.22	**15**

Source: Field survey, 2025

The results showed that the most significant barrier to green building practices and sustainable land use planning in Nigeria is the *high initial cost of green building materials (WMS = 4.06, Rank 1).* This indicates that affordability remains a critical challenge, as many developers perceive green technologies as financially demanding. This aligns with Darko and Chan (2017), who highlighted cost implications as a primary deterrent to green building adoption in developing countries. Similarly, *lack of government incentives and subsidies (WMS = 3.96, Rank 2)* and *weak enforcement of planning policies (WMS = 3.92, Rank 3)* were also rated highly, suggesting that institutional shortcomings undermine efforts to mainstream sustainable practices. Other barriers such as *limited technical expertise (WMS = 3.89, Rank 4)* and *poor public awareness (WMS = 3.86, Rank 5)* highlight capacity gaps and low stakeholder engagement, consistent with the findings of Oladokun and Aina (2011), who observed that knowledge and awareness significantly shape sustainability practices in Nigeria's built environment. Lower-ranked barriers, such as *weak stakeholder collaboration (WMS = 3.54, Rank 15),* though less emphasized, still reflect structural weaknesses in governance and coordination.

These findings imply that overcoming cost barriers through targeted subsidies, tax rebates, and accessible green financing is critical for scaling green building adoption. Strengthening institutional frameworks, particularly in policy enforcement, will ensure compliance and reduce governance bottlenecks. Furthermore, bridging knowledge and technical gaps through professional training, public sensitization, and curriculum integration can boost awareness and build local expertise. Ultimately, addressing these barriers is essential for Nigeria to achieve sustainable land-use planning and align urban development with global sustainability targets.

Conclusion

This study examined how existing land-use patterns and governance structures influence the uptake of green building practices, the ways in which integrating green principles contributes to sustainable land-uses, and the barriers that constrain adoption in Nigeria. The findings revealed that effective governance frameworks and supportive land-use

policies strongly encourage green building uptake, particularly through compact urban development, ecosystem conservation, and reduction of urban sprawl. However, significant constraints such as high initial costs, weak enforcement of planning regulations, limited technical expertise, and low awareness hinder widespread implementation. These results highlight a dual challenge: while stakeholders recognize the potential of green building to foster sustainable land use, institutional and financial bottlenecks continue to slow progress.

Recommendations

Based on these insights, several recommendations are proposed. They include:

i. Government should establish and enforce comprehensive green building codes, integrate them into urban land-use plans, and provide clear regulatory frameworks to reduce inconsistencies.
ii. Introduce subsidies, tax rebates, and low-interest credit facilities to offset the high initial costs of green building technologies and materials.
iii. Organize training programs, workshops, and campaigns to improve technical expertise among professionals and increase public awareness of the economic, social, and environmental benefits of green building.
iv. Strengthen partnerships between government, private developers, research institutions, and civil society to foster knowledge sharing and ensure coordinated sustainable land-use planning.
v. Incorporate green building principles and sustainable land-use strategies into tertiary curricula and promote applied research that addresses local climate, cultural, and socio-economic realities.
vi. Encourage the development and use of locally available, cost-effective green building materials to reduce dependency on expensive imports and improve affordability.

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