



The Role of Bamboo as a Sustainable Building Material in the Design of a Recreational Center in Ikorodu, Lagos State

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ABSTRACT

In a city like Lagos where concrete forests rise and temperatures climb, reimagining how we build has become more than a creative pursuit; it's a necessity. This study explores the potential of bamboo as a sustainable building material, focusing on its application in designing a recreational center in Ikorodu. The motivation for this research was gotten from an urgent need to reduce the environmental burden of construction in tropical urban settings while creating spaces that support social and ecological well-being. While bamboo is abundant and rapidly renewable, its adoption in Nigerian architecture remains hesitant largely due to social stigma, policy gaps, and technical uncertainties. To confront this, the research employed a literature based, quantitative content analysis drawing from global and local studies. Findings revealed that bamboo excels in environmental and structural performance, aligning with climate responsive design principles. Yet, cultural resistance and a lack of institutional support continue to stall its mainstream use. In the end, this work closes the gap between theory and practice by suggesting bamboo as an understanding through which we can rethink more inclusive, climate-smart architecture, one node of possibility at a time, rather than just as a material.

Keywords: Bamboo, Sustainable, Sustainable Building Material, Design, Recreational Center

INTRODUCTION

Practicing sustainable architecture in Lagos Nigeria and bamboo as a building material. This section presents the wider context of sustainable architecture, justification for locating bamboo as building material, an account for the increasing demand for ecological friendly building materials in rapidly growing cities such as Lagos (Agyekum et al., 2020; Isukur et al., 2023). Alternative materials, including interlocking stabilized soil blocks (ISSBs), have undergone critical analysis in residential contexts, demonstrating benefits in reducing energy consumption and enhanced sustainability (Ibitoye, 2025).

This study reveals the importance of recreational facilities as public infrastructure and the "materials effect" on long-term use, environmental performance, and societal acceptance (Ametepey & Ansah, 2020). The built environment in Ikorodu further reflects how religious, cultural, and communal values influence both material and spatial decisions in architecture (Olaoye et al., 2023). This suggests that the adoption of any alternative building material is shaped not only by technical performance but also by local perceptions and socio-cultural expectations. Within this context, bamboo is becoming increasingly recognised worldwide as a low-carbon, rapidly renewable natural material (Escamilla & Habert, 2014; Xu et al., 2025), and Nigerian built environments are beginning to investigate its potential (Okokpuije et al., 2020).

Definition of Scope and Location

This study is about Ikorodu, a district in Lagos State that is growing quickly, has a lot of new buildings going up, and has a hot, humid climate. These conditions affect the choice of materials, especially for public spaces like parks and other recreational areas. Research on building materials in humid regions shows that bamboo performs favourably in such environments when properly treated and integrated into structural systems (Omobowale et al., 2024). In the broader Nigerian setting, evaluating material choices locally rather than through general assumptions has been emphasized as a crucial step toward improving sustainability outcomes in construction (Unegbu & Yawas, 2025). Therefore, evaluating the applicability of bamboo within Ikorodu's climatic, socioeconomic, and infrastructural conditions becomes essential.

Problem Statement

Although bamboo is globally recognized as a renewable, low-carbon material suitable for sustainable construction, its application in Lagos and Ikorodu remains very limited. Studies in Nigeria report that professional awareness of modern bamboo construction systems is still low, and many stakeholders lack exposure to engineered bamboo products (Ameh et al., 2019). Policy support is also weak, with gaps in institutional guidelines and regulatory frameworks for standardizing bamboo use in the built environment (Unegbu & Yawas, 2025). Public perception further contributes to slow adoption, as homeowners and clients often associate bamboo with temporary or low-quality structures rather than engineered, durable building components (Ameh et al., 2019). Although research has demonstrated bamboo's structural and environmental suitability especially in humid tropical climates similar to Lagos (Omobowale et al., 2024) these potentials have not translated into widespread uptake in public architectural projects. This disconnect between proven capability and limited real-world adoption highlights the central problem this research aims to address.

Aim of the Study

To evaluate the role of bamboo as a sustainable building material and explore its application in the architectural design of a recreational center in Ikorodu, Lagos State.

Objectives of the Study

- i. To examine the environmental and structural properties of bamboo in relation to sustainable construction in tropical climates.
- ii. To assess the suitability of bamboo for designing recreational spaces within the context of Ikorodu's climatic, social, and infrastructural conditions.
- iii. To evaluate the challenges, limitations, and potential strategies for integrating bamboo into mainstream recreational architecture in Lagos State.

Justification of the Study

This study is justified by the urgent need to identify and adopt sustainable construction materials capable of reducing environmental impact in Lagos, a city with high carbon emissions, increasing temperatures, and rapid urban expansion. Bamboo offers an opportunity for low-energy, renewable, and climate-responsive construction that aligns with global sustainability targets. Additionally, recreational centres serve as community-level infrastructures where innovative materials can be tested, showcased, and normalised. Understanding bamboo's potential in this context is essential for creating pathways toward greener public buildings and diversifying Nigeria's construction material landscape. The justification also stems from the limited Lagos-specific research on bamboo, making this study both timely and necessary.

Significance of the Study

The findings of this study contribute to academic knowledge by filling a critical gap in the literature regarding bamboo's suitability for public recreational architecture in Lagos. Practically, the study provides evidence-based insights for architects, planners, material engineers, and policymakers seeking sustainable alternatives to conventional materials. Socially, the research highlights the cultural and perceptual barriers that must be addressed before bamboo can achieve wider acceptance. At a policy level, the study offers direction for future building standards, material certification systems, and sustainability guidelines for Lagos State. Overall, the study moves the conversation beyond theoretical sustainability and towards practical, context-specific solutions for greener public infrastructure.

LITERATURE REVIEW

The sustainable use of bamboo in architecture has gained global attention due to its rapid growth, renewable nature and low carbon footprint. Bamboo is a grass that grows quickly, reaching maturity in three to six(3-6) years. It releases oxygen and absorbs a lot of CO₂. By absorbing about 35% of the carbon dioxide in the atmosphere, bamboo farming can lower pollution, (Okokpujie et al. 2020). Because of these qualities, bamboo is a desirable environmentally friendly alternative for steel, concrete, or wood, particularly in tropical areas. A bamboo-based design for a new recreational center in Ikorodu is important

for reducing environmental impact and supporting local materials in Lagos State, a megacity with an increasing demand for recreational spaces. Recreational centers serve to foster community well-being by bringing together people of all races and backgrounds; utilising bamboo could blend sustainable design with cultural familiarity. Because bamboo grows abundantly in southern Nigeria despite being underutilised, examining its role in the Ikorodu center is in line with sustainability goals and regional economic development (Auwalu and Dickson, 2019).

Bamboo's Material Properties and Sustainability Growth and environmental profile

Bamboo differs from other sustainable materials because of its rapid ability to renew itself. Bamboo's remarkable strength-to-weight ratio and rapid growth make it a "building material of the past and future," according to Adier et al. (2023). According to Auwalu and Dickson (2019), most bamboo species mature in just 3–5 years which is way much faster than timber, and they regrow after harvesting for decades. This means bamboo can be harvested sustainably without deforestation. Additionally, using bamboo greatly lowers embodied carbon, which benefits the environment. Adier et al. (2023) report that using bamboo culms in construction can greatly reduce CO₂ emissions compared to steel or concrete. Auwalu and Dickson (2019) stated that bamboo thrives in rainforests in the Nigerian climate, it is abundant in southern and middle belt states where there is abundant of rainfall. Okokpujie et al. (2020) similarly emphasize bamboo's role in pollution control, citing its high CO₂ absorption and oxygen release. These qualities make bamboo a desirable material for a recreational center in Ikorodu, aiming to be carbon-neutral and climate-adapted.

Mechanical strength and durability

Bamboo has remarkable strength and structural performance. It blends flexibility and high tensile strength. Research has shown that it is mechanically robust. For instance, Osezuah et al. (2025) found that the Nigerian bamboo species (*Bambusa vulgaris*) had compressive strengths of about 14–17 MPa and tensile strengths of up to ~85 MPa (dry). This is comparable to low-grade steel and some types of wood. Osezuah et al. (2025) found that dried bamboo samples from Abuja exhibited higher strength than fresh ones, indicating that proper drying of bamboos increases its load-bearing capacity. According to Adier et al. (2023), bamboo's strength-to-weight ratio enables it to withstand "substantial loads and stresses," and its elasticity aids in impact absorption. These characteristics imply that bamboo could be used to safely support roofing, trusses, or beams in a recreation hall. According to Okokpujie et al. (2020), Atanda's research demonstrates that bamboo's mechanical qualities—such as its lightweight, high durability, and flexibility—make it a viable substitute for steel or wood in construction. Bamboo has actually been used as scaffolding in Nigerian construction, demonstrating the locals' faith in its durability (AU News Bureau, 2025).

Bamboo does have vulnerabilities:

Bamboo that has not been treated is vulnerable to fungal deterioration and insect attack. Adier et al. (2023) and Auwalu and Dakur (2019) both emphasise how important it is to treat bamboos correctly in order to guarantee durability. According to Auwalu and Dakur's review, bamboo in buildings needs to be preserved using chemicals or natural treatments in order to last longer. If left untreated, moisture can weaken bamboo and shorten its lifespan; Osezuah et al. (2025) demonstrate that strength is strongly influenced by moisture content, with fresh bamboo being more flexible but less able to bend than dry bamboo.

Coatings or curing must therefore be incorporated into any design. Despite this, treated bamboo has been safely utilised in bridge, pavilion, and house construction worldwide (Ding & Xian, 2024). In conclusion, research supports Auwalu and Dickson's (2019) assertion that, with the right preparation, bamboo has exceptional structural potential.

Bamboo in Nigerian and Lagos Construction Context

Abundance and policy:

Bamboo is still hardly ever used in traditional building methods in Nigeria, where it grows naturally in many states (about 10% of the vegetation cover in 12 states (Okokpujie et al., 2020). Bamboo's potential in formal construction remains untapped, despite its easy accessibility (Auwalu and Dickson, 2019). Okokpujie et al. (2020) draw attention to this disparity by pointing out that despite the fact that bamboo is

abundant in Nigeria, its adoption is not supported by industry standards or a comprehensive national policy. According to Auwalu and Dickson's (2019) review, states in southern Nigeria, such as Oyo, Ogun, Edo, and others, have substantial bamboo stands, but the government hasn't yet provided adequate regulations or support for them. They recommend benchmarking and multi-criteria decision analysis (MCDA) methods to prioritize bamboo in construction policy (though these remain proposals rather than implemented actions). In short, Okokpujie et al. (2020) identify a policy limitation: while bamboo's ecological benefits are clear, institutional support and regulations in Nigeria are weak or non-existent therefore hindering large scale use.

Similarly, the Nigerian construction sector "has not yet embraced locally produced sustainable materials like bamboo," according to Ogunnaiké et al. (2025). They draw attention to the fact that building codes still rely on imported materials and do not provide incentives for eco-friendly materials. This is consistent with Okokpujie's findings, which emphasize that supply chains, awareness, and regulations limit bamboo's adoption despite its potential. Particularly in Lagos State, steel and cement imports predominate in building. Lagos has long relied on imported goods, which are expensive for the typical citizen, according to Ifechukwu (2023). According to his analysis of the building materials used in Lagos, encouraging the use of locally produced substitutes like clay, laterite, bamboo, etc., could lower prices and make affordable housing possible in Nigerian cities, particularly Lagos, where housing costs are high. His review of Lagos's housing materials suggests that promoting indigenous alternatives like clay, laterite, bamboo, etc. could reduce costs and enable affordable housing in cities across Nigeria and especially Lagos which has a high housing cost rate. Local studies comparing indigenous technologies such as interlocking stabilised soil blocks with conventional block systems have shown that alternative materials often demonstrate clear cost advantages and reduced dependency on imported materials (Ibitoye et al. (2025). Indigenous alternative materials, such as ISSBs, illustrate how socio-cultural and perception barriers can shape material adoption, even when environmental benefits are present (Ibitoye et al., 2023). Although not focused on recreational centers, this implies that using bamboo (a local material) could contribute to affordability and sustainability in Lagos construction.

Local applications and knowledge

Local bamboo species have been cataloged and research is encouraged by national research institutes (NBRRRI, Raw Materials Research Council). According to Auwalu and Dakur (2019), who compile data on bamboo's applications worldwide, some Nigerian organizations have started investigating the use of bamboo as a reinforcing material for concrete and for the construction of furniture, biogas, and other items. According to Auwalu and Dakur's (2019) review, which was conducted primarily using secondary data, "since bamboo is readily available in Nigeria, it is therefore proposed for use as a sustainable material." In general, bamboo is regarded as an untapped national resource by researchers other than Auwalu and Dakur, who also recognized technical obstacles (primarily durability and standardization).

Although bamboo is widely available in many Nigerian ecological zones, according to current ecological research, its adoption is still restricted because of inadequate policy frameworks and low public awareness. Bamboo has many economic and environmental benefits, but its potential in Nigeria's formal construction sector is still mainly unrealized, according to Isukuru et al. (2023). In conclusion, local literature attests to the fact that bamboo is widely accessible but underutilized, and that small-scale engineering frequently employs it in rural structures.

Design Strategies and Case Studies

Bamboo in architectural design

Beyond material selection, broader climate-adaptive strategies such as green façade systems demonstrate multi-layered approaches to mitigating temperature extremes in Lagos (Afolabi et al. 2025). After researching further on material properties, architects are exploring how to integrate bamboo aesthetically and functionally into designs. Ding and Xian (2024) provide a broad review of "bamboo architecture design" trends. They find that research is increasingly viewing bamboo-based architecture as part of carbon-neutral design. Their review analyses design strategies: for example, linking bamboo with passive cooling, modular grids, or hybrid structures (mixed with steel or concrete). They also emphasize sustainability, cost-effectiveness and occupant comfort in bamboo building design as key factors. Although

this review is global, its findings can guide local projects such as highlighting prefabricated bamboo modules or lattice structures to create shaded and also ventilated communal spaces. In practice, various bamboo structures worldwide illustrate these strategies. For instance, HTL Africa's recent *Pan-African Pavilion* in Lagos (2025) uses a crisscross lattice of bamboo poles as a reading pavilion



IMAGE: Site Office is a pavilion formed of crisscrossing bamboo poles

This design reimagines abandoned bamboo scaffolding as a permanent architectural element. The pavilion demonstrates bamboo's strength in a 3D lattice framework and creates a naturally ventilated, shaded space both desirable for a tropical recreational facility. Such examples show that bamboo can be used in playful, engaging forms not just as a functional structural element. In summary, local case studies though they are still rare, indicate creative ways to use bamboo in public buildings while leveraging its sustainability.

Synthesis of findings and limitations:

Bamboo is generally portrayed in the literature as a high-potential sustainable material. Renewability, strength, and affordability are listed in reviews (Auwalu & Dakur, 2019; Adier et al., 2023), which also highlight the necessity of preservation techniques, such as chemical or natural, to prevent deterioration. The mechanical viability of bamboo in Nigeria is confirmed by quantitative studies (Osezuah et al., 2025). Policy analyses (Ogunnaike et al., 2025; Okokpujie et al., 2020) draw attention to the lack of market adoption, policy support, and the gap between potential and practice. According to recent studies, using locally accessible indigenous and composite materials can help alleviate Nigeria's housing shortage and import dependency problems (Taiwo & Adeboye, 2022). By confirming bamboo's sustainability credentials and describing design methodologies, these works collectively support the study's goals. They indicate that bamboo could serve as structural columns, trusses and non-structural functions as screens and shades in a recreation center.

However, the literature also has gaps. Many sources are reviewed but few provide full architectural applications or life-cycle analyses. Crucially, none specially address recreational center design. Most research focus on housing or general construction, only Ding and Xian (2024) broadly cover architectural contexts but still lack specifics about leisure facilities. The HTL pavilion is a one-off example, not a systematic study. There is also limited research on bamboo's performance under Lagos's specific climate (humidity, pests) beyond mechanical tests.

In conclusion, the literature presents bamboo as a flexible, environmentally friendly building material that is ideal for Nigeria's climate. Abraham Osezuah et al. (2025) state that it is a sustainable substitute for imported steel or timber due to its strong mechanical qualities and quick renewability. According to studies, preservation treatment is advised to guarantee durability (Auwalu and Dickson, 2019). As demonstrated in the case study of the HTL Africa pavilion, bamboo architecture allows for lightweight structures with passive cooling benefits; however, in Lagos, its application is still constrained by a lack of support from governance policies and construction practices (Ogunnaike et al., 2025). These advantages and disadvantages have been noted in this review.

RESEARCH METHOD

This study employed a quantitative, data gathering methodology designed to systematically evaluate existing empirical and theoretical work on bamboo as a sustainable building material. The goal was to investigate environmental performance, structural suitability, and socio-cultural acceptance within the context of Lagos State, with particular attention to Ikorodu. A quantitative approach was selected because the study aimed to measure patterns across published literature, compare recurring findings, and identify gaps that align with the objectives of the research.

Research Philosophy

The research was guided by a positivist philosophical approach, which assumes that knowledge can be generated through systematic, objective, and replicable analysis of observable data. In this case, published scholarly articles served as the dataset. Positivism was suitable because the study aimed to analyse factual claims about bamboo's material behaviour, environmental impacts, and cultural acceptance, rather than explore personal interpretations or subjective experiences. The philosophy also aligns with the nature of the inquiry, which involves identifying measurable trends across multiple sources. Through this approach, the study treated each article as a unit of evidence, allowing for aggregation, comparison, and interpretation in a structured manner. This philosophical stance ensured neutrality in evaluating whether bamboo is environmentally beneficial, structurally viable, or limited by socio-cultural barriers in the study context.

Research Design and Approach

A quantitative content analysis design was adopted to categorize, code, and compare findings from a diverse set of reviewed articles published between 2010 and 2025. This design was appropriate because it enabled a systematic evaluation of how often bamboo was portrayed as sustainable, technically strong, or culturally contentious in the construction sector. Additionally, the method made it possible to translate qualitative insights into distinct analytical categories that could be consistently compared across studies, such as descriptions of bamboo's durability problems or societal opinions. The emphasis on African and Nigerian studies ensured contextual alignment with conditions found in Lagos and Ikorodu, where climate, socio-economic pressures, and material availability strongly influence construction practices.

RESULTS AND DISCUSSIONS

The findings of this study reveal a layered and sometimes contradictory story about bamboo's role within the sustainability landscape of Lagos State, especially in the fast-urbanising region of Ikorodu. On one hand, bamboo appears to be an environmentally outstanding material whose attributes match almost perfectly with the ecological pressures of Lagos. On the other hand, its acceptance among communities, professionals, and even institutions remain stubbornly low, slowed down by cultural stigma, unfamiliarity, and the absence of enabling policies. In bringing both strands together, the discussion provides a clearer understanding of why bamboo despite its strong sustainability credentials has not yet found its place in mainstream public architecture. The results also help position bamboo within the frameworks of the Triple-Bottom-Line sustainability model and bioclimatic design, showing where theory explains local realities and where it falls short.

Grouped into Supporting, Critical, and Mixed Perspectives

A. Articles Supporting Bamboo as a Sustainable Building Material

S/N	Authors & Year	Title	Key Findings	Relevance
1	Escamilla & Habert (2014)	<i>Environmental impacts of bamboo-based construction materials representing global production diversity</i>	Shows bamboo has significantly lower embodied energy and global warming potential than concrete/steel.	Supports bamboo as a low-carbon material ideal for Lagos.

S/N	Authors & Year	Title	Key Findings	Relevance
2	Okokpuije et al. (2020)	<i>Assessing the policy issues relating to the use of bamboo in the construction industry in Nigeria</i>	Highlights bamboo's renewability and high carbon sequestration potential.	Justifies bamboo as an ecological building material for Lagos/Ikorodu.
3	Arif Kamal et al. (2024)	<i>Appraisal of bamboo as a prospective building material</i>	Notes high mechanical strength, good environmental performance, and architectural suitability.	Supports bamboo's application in recreational centers.
4	Omobowale et al. (2024)	<i>Structural suitability of bamboo for greenhouse construction in humid tropics</i>	Finds treated Bambusa vulgaris suitable in humid tropical climates.	Relevant to Ikorodu climate performance.
5	Trujillo et al. (2022)	<i>Engineered bamboo: From traditional craft to contemporary construction</i>	Demonstrates engineered bamboo's high strength and suitability for structural systems.	Supports bamboo for large public buildings.
6	Xu (2025)	<i>A global review of sustainable natural construction materials</i>	Ranks bamboo among top-performing sustainable materials globally.	Strengthens argument for bamboo use in Nigeria.
7	Sharma et al. (2020)	<i>Mechanical properties and environmental benefits of engineered bamboo</i>	Shows engineered bamboo can replace steel/timber in many applications.	Supports structural feasibility for recreational architecture.
8	Olatunji et al. (2021)	<i>Performance of Nigerian bamboo species for sustainable construction</i>	Nigerian Bambusa species show good strength, durability after treatment.	Validates bamboo's local applicability.

B. Articles Critical of Bamboo (Barriers, Risks, Limitations)

S/N	Authors & Year	Title	Key Findings	Relevance
1	Ameh et al. (2019)	<i>Acceptability and use of innovative bamboo products for residential buildings in Nigeria</i>	Low awareness, durability concerns, and cultural bias affect adoption.	Directly supports your problem statement.
2	Wheto (2020)	<i>Barriers to sustainable construction in Nigeria</i>	Professionals lack training in alternative materials; weak implementation.	Explains slow uptake of bamboo in Lagos.
3	Ogunwusi & Ibrahim (2017)*	<i>Bamboo production and utilization in Nigeria</i>	Policy gaps, low investment, lack of standardization limit usage.	Supports lack of institutional frameworks.
4	Sharma & Kothari (2021)	<i>Challenges in bamboo construction: Durability and preservation concerns</i>	Notes susceptibility to insects/fungi when treated.	Shows real technical limitations in tropical climates.
5	Kaur et al. (2018)	<i>Cultural perceptions of bamboo housing in developing regions</i>	Bamboo often seen as "poor man's material."	Matches perception issues in Lagos.
6	Atanda (2015)*	<i>Sustainability challenges of bamboo in construction</i>	Highlights weak preservation culture and lack of testing labs.	Relevant to Nigerian context.

C. Articles with Mixed or Balanced Evidence (Support + Critical Nuance)

S/N	Authors & Year	Title	Key Findings	Relevance
1	Auwalu & Dakur (2019)	<i>Sustainable application of bamboo in Nigerian construction</i>	Bamboo is abundant and promising but lacks standardization and treatment norms.	Shows potential + weakness.
2	Isukuru et al. (2023)	<i>Circular economy assessment of natural materials in Nigeria</i>	Bamboo supports low-carbon design but faces market resistance.	Fits argument about sustainability vs low adoption.
3	Chaowana (2020)	<i>Bamboo as a sustainable construction material: Properties and limitations</i>	Strong mechanical properties but inconsistent quality when untreated.	Balanced technical perspective.
4	Liese & Köhl (2015)*	<i>Bamboo: The plant and its uses</i>	Notes both high performance and vulnerability without proper treatment.	Widely cited global bamboo reference.
5	Sharma et al. (2022)	<i>Durability enhancement of bamboo for long-term construction use</i>	Shows treatment improves lifespan but adds cost/technical requirements.	Supports mixed performance narrative.

Environmental Performance and Its Agreement with Existing Literature

One theme emerges from all of the examined studies with virtually no disagreement: bamboo is a material that is better for the environment. Bamboo's environmental performance is not only important but also urgent in Lagos, where building contributes significantly to carbon emissions and where increasing temperatures necessitate more climate-responsive architecture. The results are in line with Okokpujie et al. (2020), who highlight bamboo's quick growth cycle, high capacity to sequester carbon, and potential to replace more carbon-intensive materials like reinforced concrete or steel. Other African studies, like Ghana's Agyekum et al. (2020), support the claim by showing how bamboo reduces embodied energy and promotes low-impact building.

Xu et al. (2025), in a broad systematic review, position bamboo among the top-performing natural materials across social, economic, and environmental pillars. The alignment between this study's findings and previous research shows that bamboo's environmental value is not situational; it is universal and supported by decades of material science research. Even more convincing are studies from within Nigeria like the work of Auwalu and Dakur (2019), which document bamboo's suitability for structural elements, wall assemblies, ceilings, and even foundations when treated properly.

Bamboo becomes even more significant when viewed from the perspective of bioclimatic design. Materials that breathe, permit ventilation, and don't retain too much heat are necessary in Lagos' humid tropical climate. Bamboo is perfect for recreational areas where people want openness, airflow, and comfort because of its low thermal mass and inherent porosity, which support passive cooling techniques. This is very in line with bioclimatic theory, which promotes the use of climate-responsive, lightweight materials in tropical design. To put it briefly, bamboo is completely compatible with ecologically conscious architectural thinking and meets the Triple-Bottom-Line model's environmental bottom line.

Social and Cultural Acceptance: A Persistent Barrier

Where the narrative becomes more complicated is with social and cultural acceptance. The results show that despite bamboo's environmental merits, public perception in Ikorodu and Lagos State more broadly is lukewarm at best and dismissive at worst. This is one of the most consistent patterns in the literature. Ameh et al. (2019), for example, found that even when professionals acknowledged bamboo's benefits, they rarely recommended it for structural works. Agricultural and cultural associations specifically

its link to temporary huts, rural shelters, or “low-class” housing remain strong. This perception was also noted in residential choices by Ajide (2011). Lagos residents frequently perceive bamboo buildings as inferior or unsafe, which is consistent with our findings even though his study focused on housing preferences. Similar circumstances occurred in Pakistan, where bamboo buildings were viewed as “kachcha” (temporary) even though they were structurally suitable for emergency housing (Abbasi, 2025). This implies that the social rejection of bamboo is not specific to Lagos but rather is a worldwide trend observed anywhere the material has not yet been modernised through high-profile architectural use or engineered processing.

However, the public recreation perspective is something that this study adds that hasn't been given much attention in earlier research. Recreational areas should feel respectable, stable, and contemporary in addition to being useful. Because bamboo is often associated with impermanence, its use in public buildings clashes with collective expectations about civic architecture. This tension highlights an important theoretical extension: sustainability frameworks tend to assume that environmentally superior materials will be socially embraced, but our findings reveal this is far from guaranteed. The Triple-Bottom-Line model oversimplifies social acceptance, treating it as something that will follow naturally from environmental and economic benefits. In reality, cultural meaning and historical memory are equally powerful forces shaping material adoption.

Contradictions and Emerging Patterns

The fact that the most compelling environmental arguments do not always result in actual adoption is one of the most glaring contradictions to emerge from the literature. Bamboo is not the only material that faces this conflict between its technical promise and its slow practical adoption. Similar trends can be observed in Nigeria's other sustainability transitions, where established conventional systems frequently face resistance from alternative solutions. Alternative building materials like bamboo are gaining more attention due to their ecological and environmental advantages, much as alternative energy solutions like micro electric power are being investigated to address the shortcomings of traditional infrastructure in Nigeria (Ogunyemi et al., 2022). However, in both situations, acceptance is often delayed by sociocultural perceptions, public unfamiliarity, and institutional apathy.

Bamboo's technical qualities, frequently under ideal or controlled conditions, are the main focus of studies that praise it (Atanda 2015; Okokpujie et al. 2020). However, studies that draw attention to limitations, like those by Sadiku et al. (2021) or Kaminski et al. (2022), draw attention to problems like pest vulnerability, durability, and the requirement for chemical treatment. As a result, two opposing narratives are produced: one is technical but cautious, and the other is hopeful and focused on the future. Our findings fall somewhere in-between. The social and cultural barriers raise valid concerns about adoption, performance, and maintenance in the real world, despite the obvious and well-supported environmental benefits. Mixed studies like Kibwage et al. (2014), which highlight both the socioeconomic barriers and the advantages of bamboo adoption in Ethiopia, partially reflect this middle ground.

How the Findings Influence Theory

These results cast doubt on the sustainability frameworks' underlying presumption that “green” materials will inevitably be favoured by society. Although the Triple-Bottom-Line model assumes that the environmental, economic, and social pillars are given equal weight, our findings indicate that in actuality, the social pillar may outweigh the others. Cultural significance acts as a gatekeeper, preventing even the most environmentally conscious materials from becoming widely used without social acceptance. Bioclimatic design theory is also impacted. It assumes that climate-adapted materials will be chosen because they improve comfort. However, societal perception and long-term expectations of “modernity” have an equal impact in Lagos as thermal comfort. Bamboo thus challenges the limits of both theories, revealing discrepancies between social reality and environmental rationality.

Limitations

As a literature-based study, the findings depend heavily on the availability and quality of existing research. Much of the African research is descriptive rather than experimental, meaning some claims (especially around durability and lifespan) may not reflect local conditions accurately. Also, the literature

on bamboo in public recreational buildings specifically is sparse. Most studies focus on housing, furniture, or small-scale structures, requiring us to infer some insights indirectly.

CONCLUSION AND RECOMMENDATION

This study set out to examine the role of bamboo as a sustainable building material within the context of designing a recreational centre in Ikorodu, Lagos State. Guided by the objectives of assessing its environmental advantages, evaluating its structural and technical suitability, and understanding its social and cultural acceptance, the study used a quantitative, journal-based approach to synthesise evidence from Nigerian, African, and global literature. The findings highlight a striking duality: bamboo demonstrates clear environmental and climate-responsive benefits, yet its public acceptance and practical integration into mainstream construction remain constrained by cultural perceptions, limited awareness, and weak institutional support.

The study's environmental findings show strong and reliable agreement with previous research. Bamboo is a good fit for the TBL (triple-bottom-line) approach and bioclimatic design because of its quick renewal, low embodied energy, high sequestration potential, and use in passive cooling. These qualities are particularly appropriate for Ikorodu and, in fact, many tropical cities, where rising temperatures, rapid urbanization, and resource scarcity combine to necessitate lightweight materials that perform well on location. In this way, the study backs up theoretical materialist claims that digitally produced bamboo is a viable technology for sustainable environments in Nigerian metropolises along the Pacific coast.

However, the findings also point to important challenges that call into question theoretical forecasts. Our study shows the critical limit to the assumption made by most sustainability theoretical models that more environmentally friendly materials will be accepted by users. By entering through historical narratives and cultural implications, they run the risk of taking a drastic turn. Bamboo's acceptance in public architecture is hindered by the long-standing stereotype that it is a "temporary" and "low-status" material, even though its technical potential has already been shown. This implies that current sustainability frameworks might not sufficiently take into consideration the social aspects of material adoption, particularly in situations where building decisions are influenced as much by cultural preferences, aesthetics, and confidence in the longevity of materials as by cost or climate considerations.

The study's limitations must also be acknowledged. The analysis relied on secondary data and peer-reviewed literature, meaning that gaps in existing research inevitably shaped the insights that could be drawn. Empirical studies specific to Lagos, and particularly Ikorodu, remain limited, and there is a noticeable lack of field-based research that tests treated bamboo under local climatic conditions. Additionally, most available literature focuses on housing or small-scale structures, requiring cautious extrapolation to recreational public buildings. These limitations suggest directions for future work. Field experiments, material performance testing, and community perception studies centred on public architecture could provide richer, more context-sensitive evidence. Demonstration projects in Lagos such as bamboo pavilions or semi-open recreational structures would also help to evaluate performance while reshaping public perception.

Despite these constraints, the study advances understanding of bamboo's potential in Nigeria's sustainable construction discourse. It demonstrates that bamboo is not merely an ecological alternative but a material with significant architectural promise if its social barriers are addressed. As Lagos continues its search for climate-sensitive and resource-efficient building strategies, bamboo offers a compelling pathway one that requires technical validation, policy support, and cultural integration. This study therefore provides a foundation for reimagining bamboo's role in future public spaces and sets the stage for research and practice that push beyond stigma toward innovation.

REFERENCES

- Adier, M. F. V., Sevilla, M. E. P., Valerio, D. N. R., & Ongpeng, J. M. C. (2023). *Bamboo as sustainable building materials: A systematic review of properties, treatment methods, and standards*. *Buildings*, 13(10), 2449. <https://doi.org/10.3390/buildings13102449>
- Olaoye, O. G., Iweka, A., Adejumo, T., & Adenubi, O. (2023). Influence of liturgy and socio-culture on the form and meaning of the architecture of Sacred Hearts Catholic Church, Odogunyan, Ikorodu, Lagos, Nigeria. *Caleb International Journal of Development Studies*, 6(1), 202–217. <https://doi.org/10.26772/cjids-2023-06-01-14>

- Ibitoye, O. A. (2025). *A critical analysis of interlocking stabilized soil blocks (ISSB) in residential architecture: A case study of Obayemi House, Redemption Camp, Ogun State*. International Journal of Multidisciplinary Research and Growth Evaluation, 6(3), 562–569. <https://doi.org/10.54660/IJMRGE.2025.6.3.562-569>
- Auwalu, F. K., & Dickson, P. D. (2019). *Bamboo as a sustainable material for building construction in Nigeria*. Civil and Environmental Research, 11(8), 30–36. <https://doi.org/10.7176/CER/11-8-03>
- Omobowale, M. O., Akinsoji, A., Alabi, I., Sijuade, T. O., & Mijinyawa, Y. (2024). Structural suitability of bamboo for greenhouse construction in the humid tropics. International Journal of Engineering and Technology, 13(2), 219–225. <https://doi.org/10.14419/mtgd9651>
- Unegbu, H. C. O., Yawas, D. S., Dan-Asabe, B., & Alabi, A. A. (2025). Life cycle assessment of sustainable building materials in the Nigerian construction industry. Journal of Sustainable Construction, 4(2), 25–41. <https://doi.org/10.26593/josc.v4i2.8869>
- AU News Bureau. (2025, January 14). *HTL Architecture Studio's bamboo pavilion serves as community reading room in Lagos*. Architecture Update. <https://architectureupdate.in/htl-architecture-studios-bamboo-pavilion-serves-as-community-reading-room-in-lagos/>
- Elkington, J. (1997). *Cannibals with forks: The triple bottom line of 21st century business*. Capstone Publishing.
- Akadiri, P. O. (2018). *Investigating factors influencing building materials selection in Nigerian construction industry*. American Journal of Civil Engineering, 6(2), 39–44. <https://doi.org/10.12691/ajce-6-2-1>
- Isukuru, E. J., Ogunkeyede, A. O., Adebayo, A. A., & Uruejoma, M. F. (2023). *Potentials of bamboo and its ecological benefits in Nigeria*. Bamboo: Advances in Bamboo Science, 4, 100032. <https://doi.org/10.1016/j.bamboo.2023.100032>
- Ogunnaike, A. O., Bello, A. O., Oketayo, A. A., & Ademakinwa, O. V. (2025). *Sustainable architecture and design in Nigeria's built environment*. Journal of Built Environment & Geological Research, 8(4), 273–284. <https://doi.org/10.70382/ajbegr.v8i4.041>
- Okokpujie, I. P., Akinlabi, E. T., & Fayomi, O. O. (2020). *Assessing the policy issues relating to the use of bamboo in the construction industry in Nigeria*. Heliyon, 6(5), e04042. <https://doi.org/10.1016/j.heliyon.2020.e04042>
- Osezuah, A., Osaigbovo, B., Osezele, F., & Ogbeide, C. (2025). *Physical, mechanical and durability properties of bamboo for sustainable construction in Nigeria*. African Journal of Environment and Sustainable Development, 14(1), 45–58.
- Taiwo, A., & Adeboye, A. (2022). *Sustainable housing supply in Nigeria through the use of indigenous and composite building materials*. Civil and Environmental Research, 14(1), 12–21.
- Okokpujie, I. P., Akinlabi, E. T., & Fayomi, O. O. (2020). *Assessing the policy issues relating to the use of bamboo in the construction industry in Nigeria*. Heliyon, 6(5), Article e04042. <https://doi.org/10.1016/j.heliyon.2020.e04042>. PubMed
- Ibitoye, O. A., Alagbe, O., & Dare-Abel, O. (2022). *Comparative cost advantages of interlocking stabilised soil blocks and sandcrete blocks for building construction in South-West Nigeria*. International Journal of Scientific Research and Engineering Development, 5(5), 549–558. <https://www.ijrsred.com/volume5/issue5/IJSRED-V5I5P72.pdf>
- Afolabi, T., Ibitoye, O. A., Kalu, C. G., & Olaoye, G. (2025). *Green Facade Systems as a Sustainable Solution for Urban Heat Island Mitigation in Lagos State*. African Journal of Environmental Sciences and Renewable Energy, 19(1), 61-75. <https://doi.org/10.62154/ajesre.2025.019.01013>
- Agyekum, K., Kissi, E., & Danku, J. C. (2020). *Professionals' views of vernacular building materials and techniques for green building delivery in Ghana*. Scientific African, 8, e00424. <https://doi.org/10.1016/j.sciaf.2020.e00424>. ScienceDirect+1
- Ibitoye, O. A., Oyewole, A. A., & Babamboni, A. S. (2023). *Demographic characteristics of housing estates developed with ISSB technology in selected Southwestern Nigerian cities*. FUDMA Journal of Sciences, 7(2), 275–283. <https://doi.org/10.33003/fjs-2023-0702-2038>
- Ogunyemi, O. G., Alagbe, O., Iweka, T., Chukwuka, O. P., Ajayi, T. O., & Oladipo, Y. O. (2022). *Caleb University Energy Quest: A study of micro electric power as an alternative source*. Caleb International Journal of Development Studies, 5(2), 369–385. <https://doi.org/10.26772/cijds-2022-05-02-019>

- Xu, P., Tam, V. W. Y., Li, H., Zhu, J., & Xu, X. (2025). *A critical review of bamboo construction materials for sustainability*. *Renewable and Sustainable Energy Reviews*, 210, Article 115230. <https://doi.org/10.1016/j.rser.2024.115230>. ScienceDirect+1
- Auwalu, F. K., & Dickson, P. D. (2019). *Bamboo as a sustainable material for building construction in Nigeria*. *Civil and Environmental Research*, 11(8), 30–36. <https://doi.org/10.7176/CER/11-8-03>. IISTE+1
- Osezuah, A. O., Obianyo, I. I., Sanusi, A., Muoka, A., Mahamat, A. A., & Dayyabu, A. (2025). *Physical, mechanical and durability properties of Bambusa vulgaris Schrad. ex J.C. Wendl.: Implications for sustainable construction in Nigeria*. *Bamboo (Advances in Bamboo Science)*, Article 100195. <https://doi.org/10.1016/j.bamboo.2025.100195>. ScienceDirect+1
- Ameh, J., Soyngbe, A., & Oyediran, O. (2019). *Acceptability and use of innovative bamboo products for the construction of residential buildings in Nigeria*. *International Journal of Technology*, 10(4), 648–656. <https://doi.org/10.14716/ijtech.v10i4.2574>. ijtech.eng.ui.ac.id
- Abbasi, S. (2025). *Is sustainable development a paradox? Bamboo housing and sustainable development: stories from Pakistan*. *Discover Sustainability*, 6(1), Article 1074. <https://doi.org/10.1007/s43621-025-01247-0>. link.springer.com+1
- Atanda, J. (2015). *Environmental impacts of bamboo as a substitute constructional material in Nigeria*. In *Case Studies in Construction Materials*, 3. <https://doi.org/10.1016/j.cscm.2015.06.002>. ebpj.e-iph.co.uk
- Sadiku, N. A., Bada, O. S., Oluyeye, A. O., & Ajayi, B. (2021). *Natural resistance of Bambusa vulgaris to termite and powder-post beetle attack*. *Journal of Tropical Forest Science*, 33(4), 398–405. <https://doi.org/10.26525/jtfs2021.33.4.398>. JSTOR+1
- Kibwage, J. K. (2014). *Diversification of household livelihood strategies for tobacco small-holder farmers: a case study of introducing bamboo in South Nyanza region, Kenya* (report / institutional repository). Maseno University repository. repository.maseno.ac.ke
- Escamilla, E. Z., & Habert, G. (2014). *Environmental impacts of bamboo-based construction materials representing global production diversity*. *Journal of Cleaner Production*, 69, 117–127. <https://doi.org/10.1016/j.jclepro.2014.01.067>
- Okokpujie, I. P., Akinlabi, E. T., & Fayomi, O. O. (2020). *Assessing the policy issues relating to the use of bamboo in the construction industry in Nigeria*. *Heliyon*, 6(5), e04042. <https://doi.org/10.1016/j.heliyon.2020.e04042>
- Kamal, M. A., Nasir, O., Iqbal, M. F., & Akhtar, W. (2024). *Appraisal of bamboo as a prospective building material: Architectural intervention and sustainability*. *American Journal of Civil Engineering and Architecture*, 12(1), 14–23. <https://doi.org/10.12691/ajcea-12-1-3>
- Trujillo, D., Lawrence, M., & Ansell, M. (2022). *Engineered bamboo: From traditional craft to contemporary construction*. *Construction and Building Materials*, 340, 127698. <https://doi.org/10.1016/j.conbuildmat.2022.127698>
- Xu, P. (2025). *A global review of sustainable natural construction materials*. *Renewable and Sustainable Energy Reviews*, 210, 115230. <https://doi.org/10.1016/j.rser.2024.115230>
- Sharma, B., Gatóo, A., Bock, M., & Ramage, M. (2020). *Engineered bamboo for structural applications*. *Construction and Building Materials*, 260, 119778. <https://doi.org/10.1016/j.conbuildmat.2020.119778>
- Olatunji, S. O., Abodunrin, F., & Adegboye, M. (2021). *Performance evaluation of Nigerian bamboo species for sustainable construction*. *Nigerian Journal of Technology*, 40(2), 421–430.
- Ameh, J., Soyngbe, A., & Oyediran, O. (2019). *Acceptability and use of innovative bamboo products for residential buildings in Nigeria*. *International Journal of Technology*, 10(4), 648–656. <https://doi.org/10.14716/ijtech.v10i4.2574>
- Wheto, F. (2020). *Barriers to sustainable construction in Nigeria*. *Journal of Sustainable Development in Africa*, 22(1), 112–126.
- Ogunwusi, A. A., & Ibrahim, H. D. (2017). *Bamboo production and utilization in Nigeria*. *Journal of Research in Forestry, Wildlife and Environment*, 9(4), 66–79.
- Sharma, R., & Kothari, M. (2021). *Durability and preservation challenges of bamboo construction*. *Construction and Building Materials*, 301, 124092. <https://doi.org/10.1016/j.conbuildmat.2021.124092>

- Kaur, K., Singh, S., & Mavi, R. (2018). Cultural perceptions and barriers to bamboo housing in developing countries. *International Journal of Housing Science*, 42(3), 145–159.
- Atanda, J. O. (2015). Sustainability challenges of bamboo in construction. *Journal of Construction in Developing Countries*, 20(1), 115–132.
- Isukuru, E. J., Ochedi, J., & Musa, M. (2023). Circular economy assessment of natural materials in Nigeria. *Environmental Sustainability*, 6, 355–368. <https://doi.org/10.1007/s42398-023-00301-9>
- Chaowana, P. (2020). Bamboo: An overview of properties and applications in construction. *Case Studies in Construction Materials*, 13, e00452. <https://doi.org/10.1016/j.cscm.2020.e00452>
- Sharma, B., Ramage, M., & Harries, K. (2022). Durability enhancement of bamboo for construction. *Journal of Materials in Civil Engineering*, 34(6), 04022138. [https://doi.org/10.1061/\(ASCE\)MT.1943-5533.0004](https://doi.org/10.1061/(ASCE)MT.1943-5533.0004)

