INVESTIGATING GREEN BUILDING CONSIDERATION IN THE DESIGN AND CONSTRUCTION OF PROJECTS IN LAGOS STATE

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ABSTRACT

Purpose: *The construction industry in Lagos State struggles with unsustainable practices that contribute to environmental degradation. This study is important as it highlights the need for green building practices to promote sustainability in the Lagos State construction sector. This study aims to assess the level of awareness, implementation, and challenges of green building practices in the Lagos State construction industry. The goal is to promote environment-friendly practices in the region.*

Methodology*: A quantitative research design was employed, utilizing a simple random sampling method to administer 150 close-ended questionnaires to construction professionals in Lagos State. The study achieved an 81% response rate, with 121 participants.*

Findings*: The findings reveal a moderate level of awareness of green building practices among construction professionals in Lagos State. However, there is a noticeable discrepancy with a low prevalence of actual implementation and green retrofitting in building projects across the region. Key drivers for green building practices include government regulations, economic benefits, environmental concerns, technological advancements, and social responsibility. The study identifies several barriers hindering the widespread adoption of green building practices, such as infrastructure challenges, limited availability of green materials, skilled labour shortages, perceived risks, and concerns about greenwashing.*

Practical Implications*: The study recommends increased efforts in awareness, education, and advocacy for sustainable construction practices in Lagos State. Addressing these challenges and capitalizing on opportunities can contribute to the promotion of environment-friendly construction in Lagos State. The findings emphasize the potential for improved environmental outcomes and public health through the adoption of these practices.*

Originality/Value*: This study provides valuable insights into the current state of green building practices in the region, highlighting the complexities and opportunities in transitioning to sustainable construction methods.*

KEYWORDS: *Construction Project, Design, Green Building Consideration, Green Building Practices, Green Retrofitting.*

INTRODUCTION

Green building consideration is one of a few aspects of construction that have attracted greater attention than sustainability in recent years. This trend will likely gather momentum as general awareness of environmental matters increases (Okoye et al., 2021). Green building involves designing, constructing, and operating buildings in ways that reduce environmental impact and enhance the health and well-being of occupants. These align with the environmental aspect of sustainability (Otegbulu et al., 2011). Environmental sustainability refers to the practice of making decisions and taking actions that prioritize the health and resilience of the natural environment, ensuring that ecosystems and resources can sustain present and future generations (Tumbaga et al., 2022; Zulu et al., 2022). Adopting a green hierarchy (reduce-reuse-recycle-recover-dispose of), according to Otegbulu et al. (2011) should be the priority of every professionals in the built environment. These hierachy helps to tackle the environmental aspect of sustainability. According to Siew (2014), the construction industry possesses significant environment challenges as it is resource-intensive, and has a substantial ecological impacts. These issues include high energy consumption and emission, resource depletion, waste generation, water generation, water pollution, indoor and outdoor air pollution, soil contamination, impact on water drainage and flooding, and embodies carbon in building materials.

The construction of buildings is reported to consume 3 billion tonnes of raw materials per year, and generate between 10 and 40 per cent of the solid waste streams in most countries (Omar et al., 2019). Manufacturing many of the materials used in buildings requires consuming large amounts of energy derived from fossil fuel and displacing mega-tonnes of the earth during mining. The energy input in GJ/tonne for aluminium is 190, plastics 80-100, steel and other metals 30-50, glass 20 and cement/concrete products 1.3-5. But for every tonne of cement produced, about two tonnes of raw materials must be mined; nearly one tonne of carbon dioxide and up to 6 kg of NOx gas are produced. Building contributes significantly to global ecological degradation and greenhouse gas emissions (Windapo & Goulding, 2015). If we want to sustain our urban future, there is no other option than to build in ways that reduce environmental damage, improve the health of ecosystems, and protect natural resources. The essential requirement in this respect is, adoption of the "green building" practice (Pitroda, 2023). It is a process to create buildings and infrastructure that minimize the use of resources, reduce harmful effects on the ecology and create healthy environments for people (Macherla & Agarwal, 2023; Saleh & Al-Swidi, 2019).

As the world grapples with the challenges of climate change and environmental degradation, sustainable practices in the construction industry have become increasingly vital (Ejidike et al., 2022). Green building practices offer solutions that reduce the environmental impact of construction and enhance energy efficiency, conserve resources, and provide healthy living and working environments (Albaali et al., 2021; Gikonyo et al., 2022). Lagos State, Nigeria's economic hub and one of the fastest-growing cities in Africa, faces significant urban development challenges. Green building practices encompass a series of strategies to minimize the environmental impact created by construction process while maximizing sustainable benefits (Mmereki & Brouwer, 2022; Obafemi et al., 2023). These practices focus on energy efficiency, water conservation,

waste reduction, use of environment-friendly materials, and improving indoor air quality (Albaali et al., 2021).

Lagos State has experienced rapid urbanization, increasing demand for housing, infrastructure, and commercial spaces (Shiru et al., 2020). Lagos State construction industry plays a crucial role in meeting these demands. However, this rapid development has led to environmental challenges such as increased energy consumption, water scarcity, waste generation, and pollution (Febrianti et al., 2022). Lagos State, Nigeria's economic centre and one of the fastest-growing cities in Africa, faces significant urban development challenges that require sustainable solutions. Green building practices have gained global recognition as a response to the pressing challenges of climate change, resource depletion, and environmental degradation (Obafemi et al., 2023). These practices focus on reducing the environmental impact of buildings throughout their lifecycle, including design, construction, operation and demolition. By integrating sustainable strategies, such as energy efficiency, water conservation, waste reduction and eco-friendly materials, green buildings can contribute to a more sustainable future (Komolafe & Oyewole, 2018).

Green building consideration, including green building principles, can help mitigate these challenges by creating resource-efficient, healthy, and environment-friendly buildings. Various green building rating systems and standards exist globally, such as LEED (Leadership in Energy and Environmental Design), BREEAM (Building Research Establishment Environmental Assessment Method), and EDGE (Excellence in Design for Greater Efficiencies) (Zulu et al., 2022). These frameworks provide guidelines and benchmarks for evaluating and certifying the sustainability performance of buildings (Vagtholm et al., 2023). Understanding the current green building practices in Lagos State will help assess their alignment with these internationally recognized standards (Khan et al., 2023).

Building designs and retrofitting are crucial in implementing green building practices and achieving sustainability goals. As the construction industry focuses on reducing environmental impacts and improving energy efficiency, understanding how green building practices and retrofitting can be incorporated into different building parts becomes essential (Chowdhury et al., 2022). Green building practices encompass a range of sustainable strategies that aim to minimize the impact of the environment on buildings throughout their lifecycle (Sayer et al., 2017). The building design conceptualizes and plans a structure to meet specific functional and aesthetic requirements (Ezema et al., 2016). Green building design focuses on integrating sustainable strategies into the building's development right from the onset. This includes considerations such as site selection, orientation, energy-efficient building envelope design, natural lighting, ventilation strategies, and incorporating renewable energy systems (Nduka et al., 2015). Retrofitting refers to upgrading existing buildings to improve their energy efficiency, environmental performance, and occupants' comfort. Green retrofitting involves incorporating sustainable features and technologies into the existing building fabric (Ejidike et al., 2022). This can include improving insulation, upgrading HVAC systems, installing energy-efficient lighting, integrating renewable energy sources, and implementing water-saving measures. Retrofitting is critical in transforming conventional buildings into sustainable and eco-friendly structures (Liu et al., 2019).

The prevalence of green building practices, and green retrofitting in building projects, is a critical indicator of sustainability efforts in the construction industry (AbuMoeilak et al., 2023). As a rapidly growing urban centre, Lagos State faces serious environmental challenges and an increasing demand for sustainable building solutions. HVAC system upgrades, lighting system optimizations, renewable energy integration, and water-saving measures. Green retrofitting allows old buildings to become more sustainable, and aligned with modern environmental standards (Ejidike et al., 2022).

Green building practices offer numerous benefits to building projects regarding environmental sustainability and economic advantages (AbuMoeilak et al., 2023). They offer tangible economic benefits to building projects. Energy-efficient designs and systems reduce energy consumption, and reduce utility bills and operational costs (Opawole et al., 2022). Water conservation measures lead to reduced water usage and lower water bills. Additionally, green buildings often command high market value, attract tenants and buyers efficiently, and experience low vacancy rates (Caprotti, 2014). By adopting green building practices, stakeholders can achieve long-term cost savings and enhanced financial performance. One of the primary barriers to green building practices is the construction workers' lack of awareness and knowledge (Ejidike et al., 2022). Many workers may not be familiar with sustainable construction techniques, energy-efficient design principles, or the benefits of green building (Opawole et al., 2022).

Adopting green building practices in the construction industry is crucial for promoting sustainability and mitigating environmental impacts. However, the implementation of these practices often faces various barriers and challenges (Oviawe & Anavberokhai, 2021). As stated earlier, one of the primary barriers to green building practices is the construction workers' lack of awareness and knowledge. Many workers may not be familiar with sustainable construction techniques, energy-efficient design principles, or the benefits of green buildings. The construction industry requires specialized skills and knowledge to implement green building practices effectively (Azeem et al., 2020). However, the availability of training and educational programmes focusing on sustainable construction practices may be limited in Lagos State. This lack of training opportunities can hinder construction workers from acquiring the necessary skills to incorporate green building features and technologies into their projects (Saleh & Al-Swidi, 2019). Green building practices often require upfront investments, which can be perceived as costlier compared to conventional construction methods (Nduka et al., 2015)s. Construction workers may face financial constraints, making investing in sustainable materials, energy-efficient technologies, and green building certifications challenging. The perceived higher costs and limited access to financing options can be significant barriers to green building practices (Nduka et al., 2015).

Despite the numerous benefits, such as long-term cost savings and enhanced financial performance, the prevalence of green building practices and retrofitting in Lagos State remains unclear. This study aims to assess the level of awareness, prevalence, drivers, and barriers to green building practices among Lagos State construction professionals. The objectives of this study are: (1) to examine the level of awareness of Lagos State construction professionals regarding green building practices, (2) to examine the prevalence of green building practices and green retrofitting in Lagos State building projects (3) to determine the drivers of green building practices among construction

professionals in Lagos State, (4) to identify the barriers and challenges Lagos State construction professionals face in adopting green building and green retrofitting practices.

LITERATURE REVIEW

Green Building and Green Retrofitting

Green building refers to the practice of designing and constructing structures that are environmentally responsible and resource-efficient throughout their lifecycle, from siting to demolition (Hameed et al., 2021). This approach aims to minimize the negative impacts of buildings on the environment to enhance the health and comfort of occupants. Green retrofitting, on the other hand, involves upgrading existing buildings to improve their sustainability and energy efficiency by integrating renewable energy technologies and enhancing building systems (Nwokoro & Onukwube, 2016). This practice is essential for transforming conventional buildings into eco-friendly structures, thereby contributing to a more sustainable built environment. The rise of green building practices can be attributed to increasing awareness of climate change, resource depletion, and the need for sustainable development (Waniko, 2012). As the construction industry faces challenges related to environmental degradation, green building offers solutions that promote energy efficiency, waste reduction, and the use of eco-friendly materials (Ameh & Odusami, 2010). Various green building rating systems, such as LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Environmental Assessment Method) have emerged to guide and certify sustainable practices in construction (Olanipekun, 2016). Examples of green building practices include the installation of solar panels, energy-efficient HVAC (Heating, Ventilation, and Air Conditioning) systems, and the use of recycled materials (Nwokoro & Onukwube, 2016). The advantages of green building are numerous. They include reduced energy consumption, lower maintenance costs, and improved indoor air quality, which collectively enhance occupants' well-being (F. I. Khan & Shammi, 2022). However, challenges such as high initial costs and a lack of knowledge among professionals can hinder the widespread adoption of these practices.

Green Building Practices

Green building practices refer to a set of strategies aimed at creating structures that are environmentally responsible and resource-efficient throughout their lifecycle. These practices include energy efficiency measures, water conservation, waste reduction, and the use of sustainable materials (Eves & Kippes, 2010). By integrating these strategies, green buildings minimize their environmental impact, and enhance the health and comfort of occupants (Wilson & Tagaza, 2006). The adoption of these practices is crucial for addressing the challenges posed by climate change and urbanization, particularly in rapidly growing cities like Lagos (Sichali & Banda, 2017). Buildings that utilize green concepts typically experience numerous benefits, including reduced energy and water consumption, which leads to lower operational costs (Nduka & Ogunsanmi, 2015). Additionally, these buildings often provide improved indoor air quality and natural lighting, which enhance occupants' productivity and well-being (Opoko, Obiakor, Odutayo, & James, 2022a). The overall impact of green buildings extends beyond individual structures, promoting a more sustainable urban environment and addressing issues such as pollution and resource depletion (Umar et al., 2013). In Lagos State, the awareness and implementation of green building practices remain limited, with only a small percentage of buildings classified as green (Isyaku Mohammed, 2021). Common green building practices on construction sites

include the use of recycled materials, efficient waste management systems, energy-efficient construction techniques, and the incorporation of renewable energy sources (Wilson & Tagaza, 2006). These practices are essential for fostering a sustainable construction industry and mitigating the environmental challenges faced by the region.

Theoretical Review
For the study on "Investigating Green Building Consideration in the Design and Construction of Projects in Lagos State," the Theory of Planned Behaviour (TPB) is an appropriate theoretical framework. This theory posits that individual behaviour is driven by intentions which are influenced by three key factors: attitudes toward the behaviour, subjective norms, and perceived behavioural control (Ajzen, 1991).

In the context of green building practices, the attitudes of construction professionals towards sustainability can significantly impact on their willingness to adopt eco-friendly methods. Research indicates that there is a moderate level of awareness of green building benefits by professionals in Lagos, but the awareness does not always translate into action (Nduka, 2015; Mouzaneh et al., 2022). This gap suggests that positive attitudes alone are insufficient; there must also be supportive subjective norms, which encompass the social pressures and expectations from peers, clients and regulatory bodies that encourage sustainable practices.

Moreover, perceived behavioural control refers to the perceived ease or difficulty of performing the behaviour, which in this case includes the availability of resources, training and technology necessary for implementing green building practices. The findings from the study indicate that many professionals recognize the importance of energy-efficient systems but lack the knowledge and resources to effectively implement those (Sayer et al., 2017). This highlights a critical barrier that must be addressed to enhance the adoption of green building practices.

Furthermore, the TPB emphasizes the role of external factors, such as government policies and incentives, in shaping intentions and behaviours. The lack of robust policy frameworks in Nigeria worsens s the challenges faced by construction professionals in adopting sustainable practices (Waniko, 2012). Therefore, addressing these external factors through targeted awareness campaigns and policy-driven incentives is essential to bridge the gap between awareness and active adoption of green building practices.

In conclusion, applying the Theory of Planned Behaviour provides a full understanding of the factors influencing the adoption of green building practices in Lagos State, and highlights the need for a multifaceted approach that includes enhancing attitudes, addressing subjective norms, and improving perceived behavioural control.

Empirical Review
Level of awareness of Lagos State Construction Professionals regarding green building practices.
Ejidike et al., (2022) define awareness of green building as a strategic model promoting the understanding of its importance, with goals for public enlightenment. Okoye et al., (2021) add that awareness depends on individual commitment and understanding of sustainable principles. Studies emphasize that formal knowledge is crucial for developing

skills in green building among construction professionals (Opoko, Obiakor, Odutayo, & James, 2022b). In Nigeria, while professionals demonstrate awareness of sustainability, information sources are often limited to personal research (Ameh et al., 2007). Alsanad (2015) highlight similar challenges in Bahrain, noting interest in sustainable practices like BIPV but limited training. AlSanad, (2015) report moderate awareness in Kuwait's construction industry, recommending education programs, while (AlSurf et al., 2013) find low awareness in Saudi Arabia.

The level of awareness of green building practices among construction professionals in Lagos State is generally low, which undermines efforts toward sustainable construction in Nigeria. Studies show that despite the urgent environmental needs and energy crises in Lagos, professionals in the state's construction industry remain largely entrenched in traditional practices. Studies also show that green construction practices are seldom integrated due to misconceptions about high costs and lack of market knowledge (Otegbulu et al., 2011). These barriers stem from outdated building codes, a shortage of expertise in green technologies, and limited institutional support. For example, limited projects such as Victoria Garden City and Crown Estate incorporate some green elements, yet these developments remain exceptions in Lagos rather than the norm (Okoye et al., 2021).

Empirical findings further demonstrate that, although there is an understanding of sustainability principles by the Nigerian construction professionals, this knowledge does not translate into active practice. While Nduka (2015) found a familiarity with green building benefits among Nigerian professionals, Komolafe and Oyewole (2018) reveal a significant gap in practical application due to a lack of technological advancement and inadequate professional training. Similarly, studies in other regions indicate that even with a "moderate" awareness, as in Kuwait (Alsanad, 2015), and a higher awareness in developed economies like Washington (Jamison, 2008), actual green building adoption remains low. This demonstrates that awareness alone is insufficient without supportive policies, incentives and accessible resources.

The critical gap in the literature lies in the limited focus on end-user perceptions and adoption barriers specific to the Nigerian context, particularly Lagos, where green practices could significantly reduce environmental impact. Most studies, including those by Olanipekun (2016) and Waniko (2012), have focused on professionals' knowledge, and not on the awareness among users or clients who drive demand for green buildings. Furthermore, government inaction on policy incentives worsens the challenges for Lagos' professionals to shift to sustainable practices. Addressing this research gap requires studies that explore policy-driven incentives and awareness campaigns tailored to both professionals and the public to bridge between awareness and active adoption in green building practices.

Prevalence of green building and green retrofitting among Lagos State Construction Professional

The prevalence of green building and retrofitting among construction professionals in Lagos State is gaining momentum, driven by a combination of increasing environmental awareness and the need for sustainable practices in the construction industry. Recent studies indicated that while there is a growing recognition of the benefits associated with

green buildings, such as reduced energy consumption, lower operational costs and improved occupant well-being, there remains a significant knowledge gap among professionals regarding the effective implementation of these practices. For instance, research has shown that many construction practitioners are aware of green building concepts but lack a documented corporate philosophy for managing these issues within their organizations (Waniko, 2012).

The challenges to adopting green building practices in Lagos are multifaceted. A primary concern is the absence of a standardized rating system tailored to the Nigerian context, which complicates efforts to assess and implement green building standards effectively. According to Eves and Kippes (2010), establishing such frameworks is crucial for promoting sustainable construction practices and ensuring that project stakeholders can evaluate the environmental impact of their designs accurately. Furthermore, the perception that green buildings incur higher initial costs can deter investment, despite evidence suggesting that they lead to long-term savings through reduced energy consumption and maintenance costs (Oyewole & Komolafe, 2018).

To foster a more sustainable construction environment in Lagos State, it is essential to enhance education and training programmnes focused on green building practices (Opoko, et al., 2022). This includes providing stakeholders with access to resources that clarify the advantages of sustainable materials and techniques. Successful case studies, such as the Heritage Place in Lagos which incorporates innovative features like rainwater harvesting and energy-efficient systems, serve as valuable examples of how green building practices can be effectively implemented (Opoko, Obiakor, Odutayo, James, et al., 2022). By addressing these barriers through education, standardization, and showcasing successful projects, Lagos State can advance its commitment to sustainable development in the construction sector.

Benefits and Drivers of Green building practices among Lagos State Construction professionals

Green building practices come with substantial economic, environmental and social benefits which motivate many construction professionals in Lagos State to embrace the practices. Primary advantages already cited in the literature include; reductions in energy use, greenhouse gas emissions, and pollution as well as improved well-being and productivity for building occupants. (Nwokoro & Onukwube, 2016). Opoko, et. al (2022) highlight enhanced indoor environmental quality, which not only boosts users' well-being but also promotes the development of energy-efficient solutions. Likewise, Olusanya (2018) emphasizes that green buildings promote human well-being through environmental improvements, reduce resource consumption and enhance economic performance across a building's life cycle.

Environmental benefits drive green construction adoption, as buildings account for significant energy, water and electricity use as well as carbon emissions, all of which contribute to climate change. Through green design features like natural ventilation, solar power, and eco-friendly materials, green buildings help mitigate greenhouse gas emissions and improve air and water quality (Nwokoro & Onukwube, 2016). This environmental focus is crucial for a state like Lagos, where rapid urbanization amplifies environmental stress. Economic incentives also play a pivotal role. Green construction generates jobs,

attracts investment, and enhances property values. With Nigeria facing high unemployment rates, especially among youths (National Bureau of Statistics, 2022), the employment potential of green building projects like Eko Atlantic City and Centenary City—which promise tens of thousands of jobs—is a significant driver (World Green Building Council, 2022). Additionally, green building investments are expected to support Nigeria's goal to reduce greenhouse gas emissions by 20% by 2030 (UNHCR, 2011).

Social benefits, including improved health, productivity, and community development, further encourage green practices. With considerations for occupants' well-being, and enhancing local infrastructure, green buildings foster healthier communities (Komolafe et al., 2016). For instance, Eko Atlantic City is designed to restore land lost to erosion, exemplifying how green projects can enhance community resilience and encourage knowledge transfer in construction engineering. However, gaps in the literature exist. Limited local data on economic returns from green construction, and the challenges of adopting green practices in rapidly developing regions like Lagos, may hinder widespread adoption. Further research on green building impacts specific to Lagos could help bridge these gaps, enabling more tailored policies to support sustainable urban development in the region.

Barriers and Challenges Lagos State Construction Professionals face in adopting green building practices and retrofitting.
Construction professionals in Lagos State face some barriers and challenges when adopting green building practices and retrofitting, many of which stem from structural, economic and knowledge-related gaps. One major challenge is the high initial cost associated with green materials and technologies, which discourages stakeholders from committing to sustainable building practices (Nwogu & Emedosi, 2024). With limited financial incentives or subsidies from the government to offset these costs, developers often opt for conventional methods that appear more economically feasible in the short term (Komolafe & Oyewole, 2018). A second barrier is the lack of adequate policies and regulatory frameworks that mandate green building practices. While some policies encourage sustainable practices, there is little enforcement, which results in low compliance among construction professionals. Furthermore, the absence of stringent regulations limits the drive toward adopting retrofitting practices, and contributes to continued inefficiency in resource use and energy consumption (Nduka, 2015).

Technical knowledge and expertise gaps further constrain the adoption of green building practices. Many construction professionals in Lagos lack sufficient training on sustainable practices and techniques, and the few with the necessary expertise often charge high fees, making it cost-prohibitive for smaller firms to adopt green methods (Alsanad, 2015). This gap in knowledge also extends to clients, who may be unfamiliar with the benefits of green buildings, leading to a lack of demand for sustainable options (Waniko, 2012). The limited availability of local sustainable materials adds another layer of difficulty, as many eco-friendly materials are imported, further driving up costs and extending project timelines (Nwokoro & Onukwube, 2016). Moreover, professionals face infrastructural challenges such as unreliable power and water supply, which undermines efforts to implement energy-efficient solutions (Khan & Shammi, 2022).

In summary, Lagos State construction professionals encounter multiple obstacles in adopting green building practices due to financial, regulatory, knowledge-based, and logistical constraints. Addressing these barriers requires stronger government policies, enhanced training programs, and increased local production of sustainable materials to bridge existing gaps (Alsanad, 2015). Developing an ecosystem that supports green practices could spur the construction industry toward more sustainable practices, and benefits both the economy and the environment in the long term.

RESEARCH METHODS

This quantitative study gathered data from construction professionals in Lagos State to determine their awareness, or otherwise, of green building considerations in design and construction (Coy, 2019). Green building involves practices aimed at reducing the environmental impact of construction, such as energy efficiency and sustainable material use (Albaali et al., 2021). The target population included professionals like architects, civil and electrical engineers, builders and quantity surveyors working on public and private projects. Data were collected through an online survey using a structured questionnaire, designed to cover key aspects of green building awareness. Simple random sampling, a method which gives each participant an equal chance of selection, was used to ensure representative data.

To determine the appropriate sample size, the study used a formula based on a 95% confidence level, resulting in a target sample size of at least 100 participants. This calculation ensures that the results are statistically reliable within a 5% margin of error. Ultimately, the survey received responses from 121 professionals, providing a robust sample for analysis. The survey responses were processed and analyzed using SPSS (Statistical Package for Social Sciences), with Microsoft Excel used for preliminary editing. Descriptive statistics, such as frequencies, means, and standard deviations, were employed to understand the general trends and variances in the data.

In terms of data quality, the study assessed normality, which refers to the distribution of data points aligning with a standard bell curve—a common assumption for reliable statistical analysis. Normality checks, done through statistical tests or graphical methods in SPSS, helped confirm that the data were appropriate for further analysis and interpretation.

RESULTS AND DISCUSSION

Respondent Information

Out of 121 participants, 88.4% were male, indicating male dominance in Lagos State's construction industry. Most held B.Sc./BTech (52.1%) or M.Sc. /M.B.A. (30.6%) degrees. The specialization bias was evident with 35.5% in building and 30.6% in civil engineering. COREN and NSE registration were common (56.2%), indicating an engineering sector focus. However, limited architect (5.0%) and quantity surveyor (5.8%) participation suggests a gap in architectural and cost-related perspectives. Most had 6–10 years of work experience (40.5%), mainly from contracting organizations (62.8%) and medium-sized fully indigenous firms (86.8%). The study emphasized implementation, potentially overlooking diverse viewpoints and specialized domains.

Awareness Level of Green Building Practices among Lagos State Construction Professionals.

The section employs a Likert scale ranging from 1 to 5 for rating. Variables with a mean score exceeding 3.5 are classified as highly aware, those ranging from 2.5 to 3.4 are deemed moderately aware, and scores falling between 1.0 and 2.4 indicate a lower level of awareness.

Table 1: **Awareness Level of green building practices among Lagos State construction professionals**

Level of Awareness	Mean	S. D	Rank
Energy Efficient			
Energy-efficient HVAC (heating, ventilation, and air conditioning) systems.	3.31	1.317	1st
Integration of renewable energy sources like solar panels or wind turbines.	2.83	1.331	2nd
Proper insulation and sealing to minimize energy loss.	2.47	1.298	4th
Use of energy-efficient lighting systems (L.E.D.s)	2.59	1.202	3rd
Water Conservation			
Drought-resistant landscaping and xeriscaping	3.58	1.146	1st
Greywater recycling for non-potable uses like landscape irrigation.	3.06	1.468	3rd
Rainwater harvesting systems.	3.22	1.393	2nd
Sustainable Materials			
Use of sustainable, locally sourced building materials.	3.98	1.316	1st
Recycled or reclaimed materials for construction	3.45	1.258	2nd
Eco-friendly insulation materials like cellulose or recycled denim	2.33	1.306	3rd
Indoor Air Quality			
Proper ventilation systems to enhance indoor air circulation.	3.68	1.305	1st
Maintenance practices that reduce indoor pollutants.	3.15	1.358	2nd
Installation of air purifiers or air filtration systems.	2.71	1.411	3rd
Green Roofing and Sustainable Landscaping			
Rain gardens to manage and filter stormwater.	4.0	1.443	1st
Permeable pavements to reduce stormwater runoff.	3.35	1.302	2nd
Green roofs or living roofs with vegetation.	3.15	1.34	3rd

Table 1 serves as a comprehensive snapshot, unveiling the mean values, standard deviations and ranking of awareness among construction stakeholders, for various green building practices. The data sheds light on the nuanced perceptions within the industry, providing insights into the aspects of sustainable construction which are well-recognized and which may require additional attention.

Energy Efficiency
Energy-efficient HVAC systems (mean: 3.31, rank: 1st): This is the highest-ranked item, indicating a moderate level of awareness. Construction professionals seem well-informed about the significance of energy-efficient heating, ventilation, and air conditioning systems. Integration of renewable energy sources (mean: 2.83, rank: 2nd): This also shows a moderate level of awareness. Promoting the benefits and feasibility of integrating renewable sources further could enhance awareness. Energy-efficient lighting systems (L.E.D.s) (mean: 2.59, rank: 3rd): This indicates a moderate level of awareness. While LED lighting is recognized, there is room for improvement in understanding and adoption. Proper insulation and sealing to minimize energy loss (mean: 2.47, rank: 4th): Similar to LED lighting, there is less awareness, but it seems to be slightly lower. There could be opportunities for promoting the importance of insulation in energy efficiency.

Water Conservation
Drought-resistant landscaping and xeriscaping (mean: 3.58, rank: 1st): This is the highest-ranked item, showing a high level of awareness. Professionals seem well-informed about the benefits of landscaping practices that conserve water. Rainwater harvesting systems (mean: 3.22, rank: 2nd): There is a moderate level of awareness, suggesting that professionals recognize the importance of collecting and using rainwater. Greywater recycling (mean: 3.06, rank: 3rd): Again, a moderate level of awareness. This indicates some recognition of the potential of greywater recycling for non-potable uses.

Sustainable Materials
Use of sustainable, locally sourced building materials (mean: 3.98, rank: 1st): The highest ranked item, indicating a high level of awareness. The use of sustainable, locally sourced materials is well recognized among construction professionals. Recycled or reclaimed materials (mean: 3.45, rank: 2nd): a moderate level of awareness. The importance of using recycled or reclaimed materials is well understood. Eco-friendly insulation materials (mean: 2.33, rank: 3rd): This shows a lower level of awareness, suggesting that there might be opportunities to educate professionals on the benefits of eco-friendly insulation materials.

Indoor Air Quality
Proper ventilation systems (mean: 3.68, rank: 1st): The highest-ranked item, indicating a high level of awareness. Proper ventilation for enhanced indoor air quality is well recognized. Maintenance practices for indoor air quality (mean: 3.15, rank: 2nd): This indicates a moderate level of awareness, suggesting that maintenance practices for reducing indoor pollutants are well-recognized. Installation of air purifiers or filtration systems (mean: 2.71, rank: 3rd): a moderate level of awareness. There could be opportunities to promote the benefits of air purifiers and filtration systems for indoor air quality.

Green Roofing and Sustainable Landscaping
Rain gardens (mean: 4.00, rank: 1st): The highest-ranked item, indicating a high level of awareness. Rain gardens for managing and filtering storm water are well-recognized among construction professionals. Permeable pavements (mean: 3.35, rank: 2nd): Moderate to high awareness. Professionals seem to understand the importance of using permeable pavements to reduce storm water runoff. Green roofs or living roofs (mean:

3.15, rank: 3rd): a moderate level of awareness. Further education on the benefits of green roofs could enhance awareness.

The study findings suggest that while there is generally good awareness of green building practices among construction professionals in Lagos State, there are opportunities for further education and promotion, especially in areas where awareness is moderate or low. This information can be valuable for designing targeted awareness campaigns and training programmes to promote sustainable construction practices in the region. Drawing from empirical studies, architects in Lagos State have a general understanding of green building technologies, although they have not implemented many of these technologies in their projects (Opawole et al., 2022). Property managers, on the other hand, have a lower level of awareness about the potential benefits of vertical greenery systems (VGSs) on buildings (Opoko et al., 2022). However, the overall awareness level of property managers is still moderate.

Construction professionals in the study area are highly aware of sustainability practices and prioritize resource conservation and client satisfaction in their construction projects (Opawole et al., 2022). While there is a moderate level of awareness among construction stakeholders regarding green building practices in Lagos State, there is a need for increased implementation of these practices in building projects. This highlights the importance of targeted education and promotion efforts to bridge the gap between awareness and implementation, ultimately promoting sustainable construction practices in the region. The findings suggest that while there is generally good awareness of green building practices among construction professionals in Lagos State, there are opportunities for further education and promotion, especially in areas where awareness is moderate or low. This information can be valuable for designing targeted awareness campaigns and training programs to promote sustainable construction practices in the region.

Prevalence of Green Building Practices and Green Retrofitting in Building Projects across Lagos State
The prevalence of green building practices and green retrofitting in building projects is a critical aspect that shapes the sustainability landscape in Lagos State. This section assesses the engagement of construction professionals in building projects over the past five years, shedding light on the incorporation of green building practices and retrofitting initiatives. The responses obtained from 121 participants provided valuable insights into the current state of sustainable construction practices in the region.
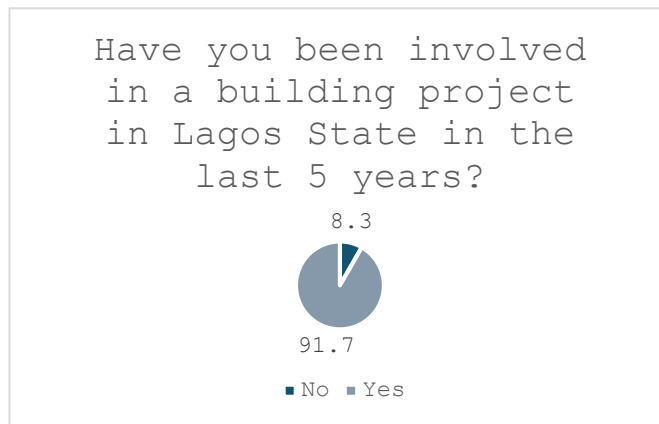
Have you been involved
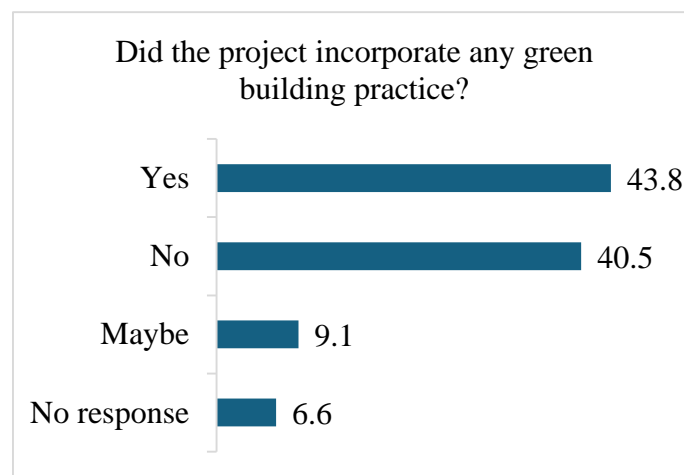in a building project
in Lagos State in the
last 5 years?

8.3

91.7

■ No ■ Yes

Figure 1: Respondents involvement in a building project in Lagos State in the last 5 years.

Did the project incorporate any green building practice?

Yes	43.8
No	40.5
Maybe	9.1
No response	6.6

Figure 2: Incorporation of green practices into projects respondents were involved in.

Have you been involved in a building retrofit project in the last 5 years?

Yes	59.5
No	36.4
Maybe	2.5
No response	1.7

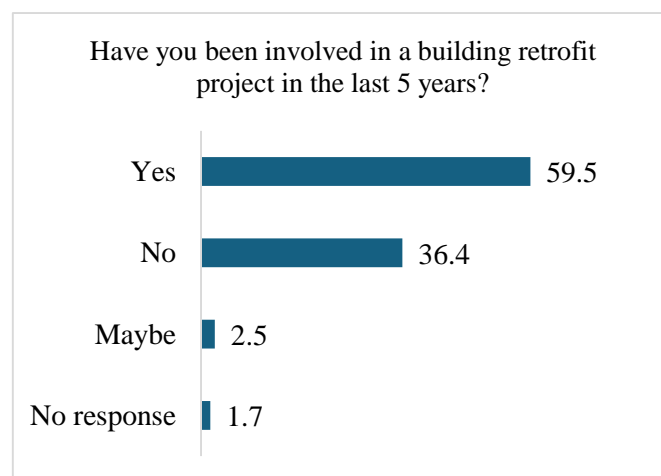**Figure 3: Respondents involvement in a building retrofit project in Lagos State in the last 5 years**

Did the retrofit project incorporate any green
retrofitting practice?

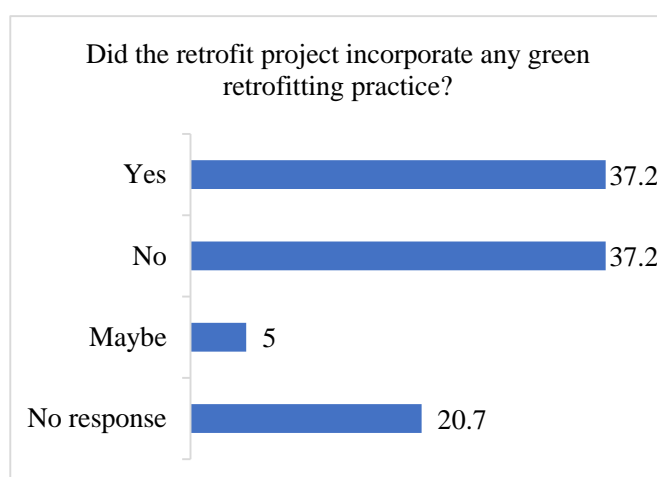|	
Yes	37.2
No	37.2
Maybe	5
No response	20.7

**Figure 4: Incorporation of green retrofitting practices
into projects respondents were involved in**.

The figures above show the prevalence of green building practices and green retrofitting in building projects across Lagos State. Out of the 121 respondents, 111 have been involved in a building project in Lagos State in the last 5 years, and 53 of those projects incorporated green building practices. Additionally, 72 respondents have been involved in a building retrofit project in Lagos State in the last 5 years, and 45 of those retrofit projects incorporated green retrofitting practices. The search results provided some context for the prevalence of green building practices and green retrofitting in Nigeria. While green building practices are not yet well developed in Nigeria, there is a growing interest in sustainability and green retrofitting practices.

Retrofitting existing buildings can improve sustainable development, decrease energy consumption, reduce maintenance costs, and mitigate climate change. Green retrofitting existing building stocks is necessary to meet national energy efficiency goals, achieve climate change's medium- and long-term objectives, and shift towards a sustainable, low-carbon economy. However, there are still challenges to implementing green retrofitting practices. They include lack of knowledge among professionals and contractors, high costs, and a lack of government incentives. Studies have shown that the adoption of sustainable practices in the construction industry in Lagos State is still relatively low (Oke & Aghimien, 2018).

The construction industry in Lagos State consumes significant energy and emits greenhouse gases, but sustainable practices are not frequently incorporated into building design and construction (Opoko et al., 2022). While some sustainable practices, such as the use of energy-saving bulbs, are implemented in mass housing projects, other practices like renewable energy technologies are rarely incorporated (M. G. Oladokun et al., 2021). Additionally, the adoption of sustainable management practices in office buildings is still limited, with property managers focusing more on energy-efficient features rather than holistic sustainability. The low prevalence of green building practices and green retrofitting in building projects across Lagos State highlights the need for increased awareness, education, and advocacy for sustainable construction practices. The growing enthusiasm for green building practices and retrofitting in the region is a positive sign, but

95

more needs to be done to promote sustainable development, and reduce the environmental impact of the construction industry in Lagos State. By incorporating sustainable practices into building design and retrofitting projects, stakeholders can improve sustainability, reduce energy consumption, lower maintenance costs, and positively impact climate change mitigation.

Drivers of Green Building Practices among Lagos State Construction Professionals.
The adoption of green building practices is driven by a multitude of factors, each playing a crucial role in shaping the sustainable construction landscape. In this section, Table 4.4 encapsulates the mean scores and standard deviations of drivers of green building practices. These statistical insights offer a quantitative exploration of the drivers motivating construction stakeholders in Lagos State to embrace environmentally responsible building practices.

Table 2: **Drivers of green building practices among Lagos State construction professionals**

Drivers of green building practices	Mean	S.D	Rank
Government regulation			
Energy efficiency standards.	3.39	1.23	1st
Environmental regulations encourage construction stakeholders to adopt sustainable practices.	3.06	1.23	2nd
Economic benefits			
Green buildings can reduce operating costs and increase property value.	3.76	1.34	1st
Increased property value.	3.46	1.4	2nd
Cost savings	3.16	1.31	3rd
Environment concerns			
Reducing carbon footprint.	3.8	1.43	1st
Green buildings reduce energy consumption, water usage, and waste generation	3.74	1.4	2nd
Conserving natural resources and reducing waste.	3.56	1.38	3rd
Technological advancement			
Renewable energy sources	3.4	1.45	1st
Adopting energy-efficient systems	3.26	1.41	2nd
Social responsibility			
Construction stakeholders who adopt sustainable practices can improve their reputation and contribute to the well-being of society and the environment	3.64	1.46	1st

Table 2 presents data on the drivers of green building practices among construction stakeholders in Lagos State, along with their mean scores, standard deviations, t-values, significance levels (Sig), and confidence intervals. Let's discuss the table comprehensively.

Government Regulations
The data shows that government regulations play a significant role in driving green building practices. The mean score for "energy efficiency standards" is 3.39, indicating that stakeholders consider these standards essential. Similarly, "environmental regulations encouraging sustainable practices" also have a relatively high mean score of 3.06, suggesting that such regulations influence stakeholders to adopt sustainable practices.

Economic Benefits
This category explores how economic incentives contribute to green building practices. "Cost savings" has a mean score of 3.16, indicating that stakeholders perceive cost savings as an important driver. "Increased property value" also scores high with a mean of 3.46. The variable "green buildings can reduce operating costs and increase property value" scores even higher at 3.76.

Environmental Concerns
The data highlights environmental concerns as drivers of green building practices. "Reducing carbon footprint" and "Conserving natural resources and reducing waste" both have high mean scores (3.80 and 3.56, respectively). The variable "Green buildings reduce energy consumption, water usage, and waste generation" also scores significantly high at 3.74. These findings demonstrate that stakeholders in Lagos State are motivated by environmental considerations when implementing green building practices.

Technological Advancements
This category delves into the role of technology in promoting green building practices. "Adopting energy-efficient systems" has a mean score of 3.26, which means that stakeholders recognize the importance of adopting energy-efficient technologies. "Renewable energy sources" also scored relatively high at 3.40.

Social Responsibility
The data shows that stakeholders consider social responsibility as a driver for green building practices. The variable "Construction stakeholders who adopt sustainable practices can improve their reputation and contribute to the well-being of society and the environment" has a mean score of 3.64. This suggests that stakeholders believe that adopting green building practices not only benefits their reputation but also contributes to the well-being of society and the environment. The findings presented in Table 2 and the studies by Umar et al., (2013), Oke & Aghimien, (2018), and Zhang & Yuan, (2020) collectively highlight the key drivers shaping green building practices among construction stakeholders.

Government regulations emerge as a crucial factor, with stakeholders in Lagos State prioritizing energy efficiency standards and environmental regulations. This underscores the importance of government policies and regulations in promoting sustainable construction practices. Economic benefits, including cost savings and increased property value, also strongly motivate stakeholders, highlighting the potential financial incentives

of sustainable construction practices. Environmental concerns, such as reducing carbon footprints and conserving natural resources, are also significant drivers, reflecting the growing awareness of the impact of construction on the environment. Technological advancements, particularly adopting energy-efficient systems and utilizing renewable energy sources, significantly influence stakeholders, indicating the importance of innovation in promoting sustainable construction practices. Social responsibility also emerges as a driver, with stakeholders recognizing the reputational and societal benefits of adopting sustainable practices.

Barriers and Challenges Lagos State Construction Professionals Face in Adopting Green Building Practices.

The adoption of green building practices is essential for sustainable development, energy efficiency, and environmental protection. However, there are several barriers and challenges that construction stakeholders in Lagos State face in adopting green building practices. Table 3 shows the mean score and standard deviation for various barriers and challenges facing construction professionals regarding the adoption of green building practices.

Table 3: **Barriers and challenges Lagos state construction professionals face in adopting green building practices.**

Barrier's construction stakeholders in Lagos State face regarding the adoption of green building practices	Mean	S.D	Rank
Difficulty in securing financing for green building projects, as financial institutions may not fully understand the risks and benefits associated with green construction.	3.91	1.58	1st
Concerns about greenwashing, where some projects claim to be green but lack true sustainability, can lead to scepticism among stakeholders.	3.31	1.14	2nd
Concerns about the perceived risks associated with green building practices, including uncertainties about the performance and durability of sustainable materials and technologies.	3.53	1.21	2nd
Green building materials and technologies can be more expensive upfront, deterring developers and investors who focus primarily on short-term costs.	3.5	1.55	3rd
Limited knowledge and awareness among stakeholders about the benefits and techniques of green building practices.	3.26	1.10	4th

A shortage of skilled workers trained in green construction techniques can impede the implementation of sustainable practices.	3.21	1.21	5th
Inconsistent or unclear green building regulations and codes	3.1	1.15	6th
Limited availability of green building materials and technologies in the local market may lead to delays and increased costs.	2.98	1.14	7th
Lagos faces infrastructure challenges such as irregular power supply and inadequate waste management which can affect the feasibility of certain green building technologies.	2.83	0.98	8th

Limited Knowledge and Awareness
The data reveals that "limited knowledge and awareness among stakeholders about the benefits and techniques of green building practices" is considered a significant barrier with a mean score of 3.26. The high mean score suggests that stakeholders may lack awareness or understanding of green building practices, which hinders their adoption.

Cost of Green Building Materials
"Green building materials and technologies can be more expensive upfront, deterring developers and investors who focus primarily on short-term costs" is another substantial barrier with a mean score of 3.50. This suggests that the higher initial costs associated with green materials deter stakeholders who prioritize short-term financial gains.

Inconsistent Regulations
"Inconsistent or unclear green building regulations and codes" is a concern with a mean score of 3.10. This indicates that the lack of clear and consistent regulations in the green building sector can hinder stakeholders' efforts to adopt sustainable practices.

Financing Challenges
The data shows that "difficulty in securing financing for green building projects, as financial institutions may not fully understand the risks and benefits associated with green construction," is a significant barrier with a high mean score of 3.91. Stakeholders face challenges in securing financial support for green projects due to a lack of understanding among financial institutions.

Infrastructure Challenges
"Lagos faces infrastructure challenges such as irregular power supply and inadequate waste management which can affect the feasibility of certain green building technologies," is a barrier with a mean score of 2.83. This suggests that the local infrastructure challenges in Lagos, such as power supply and waste management issues, impact the feasibility of certain green technologies.

Limited Availability of Green Materials

"Limited availability of green building materials and technologies in the local market" is another significant barrier, with a mean score of 2.98. This shows that the limited availability of sustainable materials and technologies locally can lead to delays and increased costs in green projects.

Skilled Labour Shortage

"Shortage of skilled workers trained in green construction techniques" is a barrier, with a mean score of 3.21. This suggests that the lack of skilled labour trained in green construction practices can impede the implementation of sustainable building techniques.

Perceived Risks

"Concerns about the perceived risks associated with green building practices, including uncertainties about the performance and durability of sustainable materials and technologies" is a significant barrier with a mean score of 3.53. Stakeholders have concerns about the risks and uncertainties associated with green building materials and technologies.

Greenwashing Concerns

"Concerns about greenwashing, where some projects claim to be green but lack true sustainability, can lead to scepticism among stakeholders," is another barrier with a mean score of 3.31. Stakeholders are wary of claims of sustainability without substance. This can lead to scepticism.

The barriers identified in Table 3 and the studies by Dania et al., (2013) and Adegoke et al., (2023) collectively shed lights on the significant challenges faced by construction stakeholders in Lagos State when adopting green building practices. "Limited knowledge and awareness" emerge as a major hindrance, indicating a need for heightened education on the benefits and techniques of green building. This aligns with the Ahn et al., (2013) study, which also highlighted insufficient awareness as a barrier to green building adoption. The "cost of green building materials" stands out as a substantial barrier, suggesting that higher upfront expenses deter those focused on short-term gains. This financial concern is further supported by the Tiberi & Carbonara, (2016) study, which recognized perceived financial risks and initial capital costs as significant barriers in the Australian context. "Inconsistent Regulations" and "Financing Challenges" also pose significant barriers, which emphasize the impact of unclear green building codes and the struggle to secure financial support due to limited understanding from financial institutions.

These findings underscore the importance of clear and supportive regulatory frameworks and financial incentives for promoting green building practices. "Infrastructure Challenges," "Limited Availability of Green Materials," "Skilled Labor Shortage," "Perceived Risks," and "Greenwashing Concerns" further highlight the multifaceted challenges impeding the widespread adoption of green building practices in Lagos State. These insights provide valuable guidance for targeted interventions to overcome the barriers, including educational initiatives, financial support mechanisms, regulatory clarity, and efforts to address infrastructure and skill shortages. Overall, the identified barriers underscore the complex landscape of challenges that need to be addressed to

facilitate the widespread adoption of green building practices in Lagos State. By understanding and addressing these barriers, stakeholders can work towards creating a more conducive environment for sustainable construction practices.

Discussion of results
The study on green building practices in Lagos State reveals a moderate level of awareness of sustainable construction methods by construction professionals. Out of 121 participants, a significant majority were male, with most holding degrees in engineering fields, indicating a strong technical background in the industry (Sayer et al., 2017). The findings suggest that while professionals are somewhat informed about energy-efficient systems such as HVAC and renewable energy integration, there remains a notable gap in the awareness of other critical aspects, such as proper insulation and eco-friendly materials. For instance, the mean awareness score for energy-efficient HVAC systems was 3.31, indicating a moderate understanding, while the awareness of proper insulation was lower at 2.47 (Mouzaneh et al., 2022). This discrepancy highlights the need for targeted educational initiatives to enhance knowledge across all facets of green building practices. Moreover, the study identified several barriers to the broader implementation of green building practices in Lagos State. Financial limitations, regulatory uncertainties, and a lack of skilled labour were cited as significant challenges (Eves & Kippes, 2010). These obstacles not only impede the adoption of sustainable methods but also reflect a broader systemic issue in the construction industry. The research emphasizes that, without addressing these barriers, the transition to green building practices will remain sluggish. The findings underscore the importance of government support and policy interventions to create a more conducive environment for sustainable construction, which is essential for meeting the demands of a rapidly urbanizing population while minimizing ecological impacts (Albaali et al., 2021). In conclusion, the study's results underscore the urgent need for a collaborative approach of stakeholders to drive the adoption of green building practices in Lagos State. The moderate awareness levels coupled with significant barriers show that while there is potential for growth in sustainable construction, concerted efforts are required to enhance understanding and application (Sayer et al., 2017). Future research should focus on longitudinal assessments of implemented strategies, and explore innovative solutions tailored to the unique challenges of the Lagos construction landscape. Such initiatives will be crucial in shaping a sustainable future for urban development in the region, ultimately leading to improved environmental outcomes and public health (Obafemi et al., 2023).

CONCLUSION
This study has critically assessed the awareness, implementation and challenges of green building practices in the Lagos State construction industry, reaffirming the thesis that sustainable construction methods are essential for addressing environmental concerns in rapidly urbanizing areas. The research findings indicate a moderate level of awareness among construction professionals, coupled with a notable increase in the adoption of green building practices. However, significant barriers, such as financial limitations, regulatory uncertainties, and a lack of skilled labor, impede broader implementation. The evidence presented in this study underscores the necessity for targeted educational initiatives and government support to enhance the understanding and application of sustainable practices in construction. By addressing these barriers, stakeholders can facilitate a robust integration of green building principles more than before. This can lead to improved

environmental outcomes and enhanced public health. In conclusion, the transition to green building practices in Lagos State is imperative for fostering a sustainable construction industry that can meet the demands of a growing population while minimizing ecological impacts. The findings of this research not only contribute to the academic discourse on sustainable construction but also provide policymakers and industry leaders' practical insights into promoting environmentally responsible practices. As a final thought, the implications of this study extend beyond immediate recommendations. They highlight the urgent need for a collaborative approach among stakeholders to drive the adoption of green building practices. Future research should focus on longitudinal assessments of the effectiveness of implemented strategies, and explore innovative ways to overcoming the unique challenges of the Lagos State construction landscape. Such efforts will be crucial in shaping a sustainable future for urban development in the region.

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