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Advancing Sustainable Construction in Nigeria: A Critical Review of Progress, Challenges, and Future Direction

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ABSTRAK

Tinjauan literatur ini mengkaji kemajuan, tantangan, dan peluang dalam mengadopsi praktik konstruksi berkelanjutan di Nigeria selama dua dekade terakhir. Kemajuan signifikan telah dicapai, khususnya dalam penggunaan bahan bangunan yang efisien energi dan *Building Information Modeling* (BIM), yang telah meningkatkan efisiensi dan keberlanjutan proyek. Kerangka kebijakan telah berkembang untuk mendukung inovasi teknologi ini, tetapi adopsi luas dari praktik berkelanjutan masih terhambat oleh keterbatasan ekonomi, resistensi budaya, dan kekurangan regulasi. Tantangan ekonomi, terutama biaya tinggi teknologi berkelanjutan, adalah hambatan utama, yang diperburuk oleh insentif keuangan yang terbatas dan ketidakstabilan ekonomi. Faktor budaya, seperti preferensi terhadap metode konstruksi tradisional, dan penegakan kode bangunan yang tidak konsisten semakin mempersulit upaya untuk mempromosikan keberlanjutan. Meskipun ada hambatan-hambatan ini, kesadaran akan pentingnya mengintegrasikan keberlanjutan ke dalam sektor konstruksi semakin meningkat, didorong oleh kekhawatiran lingkungan global dan kebutuhan pembangunan lokal. Tinjauan ini juga menyoroti keterbatasannya, termasuk ketergantungan pada literatur akademik yang diterbitkan, yang mungkin tidak sepenuhnya mencerminkan tren industri terbaru atau realitas lokal. Mengabaikan literatur abu-abu dan publikasi non-Inggris dapat menghilangkan perspektif regional yang penting. Tinjauan ini merekomendasikan penelitian di masa depan mengenai analisis ekonomi yang lebih rinci tentang teknologi berkelanjutan, menjelajahi integrasi praktik tradisional dan modern, serta studi perbandingan dengan negara-negara serupa.

Keywords: *cultural resistance; economic constraints; green technologies; policy development; sustainable construction*

ABSTRACT

This literature review examines the progress, challenges, and opportunities in adopting sustainable construction practices in Nigeria over the past two decades. Significant advancements have been made, particularly in the use of energy-efficient materials and Building Information Modeling (BIM), which have improved project efficiency and sustainability. Policy frameworks have evolved to support these technological innovations, but widespread adoption of sustainable practices is still hindered by economic constraints, cultural resistance, and regulatory gaps. Economic challenges, especially the high costs of

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sustainable technologies, are major obstacles, worsened by limited financial incentives and economic instability. Cultural factors, such as a preference for traditional construction methods, and inconsistent enforcement of building codes further complicate efforts to promote sustainability. Despite these barriers, there is growing awareness of the need to integrate sustainability into the construction sector, driven by both global environmental concerns and local development needs. The review also highlights its limitations, including a reliance on published academic literature, which may not fully capture recent industry trends or local realities. Excluding grey literature and non-English publications may omit important regional perspectives. The review recommends future research on detailed economic analyses of sustainable technologies, exploring the integration of traditional and modern practices, and comparative studies with similar countries.

INTRODUCTION

Environmental sustainability in construction is crucial for mitigating the adverse effects of urbanization and industrialization. The construction sector is a significant contributor to environmental degradation due to its high resource consumption, energy use, and waste generation. The industry accounts for about 36% of global energy consumption and nearly 40% of carbon dioxide emissions, highlighting its substantial environmental impact (International Energy Agency, 2022; Huang et al., 2021). The demand for new infrastructure, driven by population growth and urban expansion, exacerbates these issues, requiring large quantities of raw materials that often disrupt ecosystems and increase pollution (Worrell et al., 2020). Additionally, construction processes, from material production to building assembly, contribute significantly to energy consumption and greenhouse gas emissions (Giesekam et al., 2020).

These activities not only harm ecosystems but also pose risks to human health and contribute to climate change, impacting water resources and food security (WHO, 2021). Therefore, the construction industry plays a critical role in global efforts to combat climate change and promote sustainability. There is increasing pressure on the sector to adopt sustainable practices, such as using recycled materials, green building technologies, and energy-efficient designs, which are essential for reducing its ecological footprint (Lucon et al., 2023). Sustainable construction also integrates economic and social considerations, aiming to balance environmental protection with economic growth and social equity (Hill & Bowen, 2022).

Nigeria's construction industry faces specific challenges in achieving sustainability. Energy-intensive processes and inadequate waste management are significant issues, leading to high costs and environmental pollution (Adeyemi et al., 2022; Oyedele & Ajayi, 2021). The reliance on non-renewable materials like cement and steel further contributes to CO2 emissions and resource depletion (Adeyemi et al., 2022). However, opportunities exist to promote sustainability, such as using locally sourced materials like laterite and bamboo, which can reduce emissions and support

local economies (Mbachu & Nkado, 2019). Implementing energy-efficient technologies, including passive solar design and photovoltaic systems, can also significantly reduce buildings' energy consumption (Olubunmi et al., 2021). Adherence to green building standards, such as those from the Green Building Council of Nigeria and LEED certifications, can drive the adoption of sustainable practices and improve occupant well-being (Adeleke et al., 2022).

This review systematically examines sustainable practices in Nigeria's construction industry, focusing on recent studies from the past five years. It explores key areas, including technological innovations, policy implementation, and economic barriers, providing a detailed perspective on sustainability in the region (Olubunmi et al., 2021; Olotuah & Adesiji, 2023). The review highlights how local values and traditional methods influence the adoption of sustainable practices, offering insights into the societal factors at play (Amasuomo et al., 2021). By concentrating on Nigeria, this review provides a comprehensive synthesis of the current state of sustainable practices in the construction sector, outlining progress, challenges, and potential strategies for improvement.

The article aims to map the progress and identify challenges in environmental sustainability within Nigeria's construction industry. It focuses on three objectives: identifying key sustainable practices, analyzing barriers to their adoption, and discussing broader implications for policymakers and stakeholders. This discussion seeks to inform policy, guide industry decisions, and highlight areas for future research, ultimately contributing to the advancement of sustainable construction practices in Nigeria.

LITERATURE REVIEW

Overview of Sustainable Construction: Global Context and Significance

Sustainable construction is crucial for addressing the environmental challenges posed by the construction industry, which contributes around 40% of global energy consumption and one-third of greenhouse gas emissions (UNEP, 2019). The sector's environmental impact necessitates practices that reduce resource consumption, waste, and pollution. Globally, initiatives like the UN's Sustainable Development Goals (SDGs), particularly Goals 11 and 12, emphasize sustainable urban development and consumption patterns. Certifications such as LEED, BREEAM, and GBI establish standards for eco-friendly construction. Innovations like recycled concrete, bamboo, and low-VOC paints, alongside energy-efficient technologies such as smart HVAC systems and photovoltaic solar panels, are vital in reducing buildings' carbon footprints. Modular construction and 3D printing further enhance efficiency by minimizing waste, with modular construction reducing waste by up to 90% compared to traditional methods (Smith, 2020). Economically, green buildings offer long-term savings through lower operating costs, reducing energy consumption by up to 50% (WGBC, 2018).

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Socially, sustainable buildings improve occupant health and productivity by enhancing indoor environments.

Historical Context in Nigeria: Addressing Sustainability in the Construction Sector

Nigeria's construction sector has evolved in response to economic and environmental challenges. Post-colonial Nigeria prioritized rapid infrastructure development, often at the expense of environmental considerations. The construction boom of the 1970s and 1980s, driven by oil revenues, led to projects that largely ignored sustainability, resulting in ecological degradation (Oyeyipo et al., 2015; Adeyemi et al., 2017). The 1992 Earth Summit spurred Nigeria to integrate some sustainable practices, but these were hindered by weak institutions and corruption, often driven by external agencies rather than local strategies (Ibem et al., 2011; Ibem & Amole, 2012). The establishment of the Nigerian Building and Road Research Institute (NBRRI) and the Green Building Council of Nigeria marked a shift towards formalized sustainability practices (Nwokoro & Dekolo, 2010). Despite progress, challenges persist, including weak enforcement of building codes and a preference for traditional methods over green alternatives (Oladokun et al., 2016). However, in urban areas like Lagos, private developers are gradually adopting international sustainability standards such as LEED and EDGE, indicating a positive shift towards sustainable construction (Adeleke et al., 2019).

Recent Developments in Sustainable Construction Practices

The global construction industry has recently embraced sustainable practices more widely, driven by the need to mitigate environmental impacts and improve energy efficiency. Building Information Modeling (BIM) has been pivotal, in improving project planning, resource management, and waste reduction (Succar, 2009). The move towards net-zero buildings, incorporating renewable energy sources like solar and wind into designs, has gained momentum (Ramesh et al., 2010). Sustainable materials, such as recycled concrete and bamboo, have become more prevalent, supporting circular economy principles (Kibert, 2016). In Nigeria, progress has been slower. The National Building Code's provisions for energy efficiency represent a significant policy step (Federal Ministry of Works and Housing, 2006). Green building technologies, such as solar energy systems, are increasingly adopted in urban projects, with the Green Building Council of Nigeria promoting these practices through certification programs (GBCN, 2018). However, the widespread use of sustainable materials is limited, with traditional materials still dominating due to cost and availability (Ameh & Daniel, 2013).

Technological Innovations: Examination of New Technologies that have Influenced Sustainable Construction

Technological innovations have greatly influenced sustainable construction practices, particularly in Nigeria. Building Information Modeling (BIM) has improved resource management, reduced waste, and enhanced project sustainability (Succar, 2009; Wong et al., 2014). Green building materials, such as low-carbon concrete and recycled steel, reduce buildings' carbon footprints, with pozzolanic cement, made from rice husk and volcanic ash, offering a more sustainable alternative to traditional cement in Nigeria (Van Deventer et al., 2012). The integration of renewable energy technologies, such as photovoltaic solar panels and solar water heaters, is also critical, with Nigerian government initiatives supporting these systems in building designs (Oyedepo, 2012). Smart technologies, including automated HVAC systems and smart lighting, are emerging in Nigeria, showing potential for energy conservation and management in urban developments (Agboola et al., 2016).

Policy and Regulations: Analysis of the Impact of Government Policies on Promoting Sustainability in Construction

Government policies are crucial in promoting sustainable construction in Nigeria. The Nigerian Building Code was one of the earliest efforts to integrate sustainability into construction, though its impact has been limited by weak enforcement and low stakeholder awareness (NBRRI, 2006; Adeleke et al., 2019). Newer policies, such as those enforced by the National Environmental Standards and Regulations Enforcement Agency (NESREA), have improved compliance with environmental regulations (NESREA, 2010). The National Policy on the Environment (2017) provides a framework for sustainable practices, emphasizing the construction sector's role (Federal Ministry of Environment, Nigeria, 2017). However, the adoption of sustainable practices varies, with urban commercial projects more likely to comply due to greater regulatory oversight, while traditional practices persist in rural areas (Olusola et al., 2012; Okoye et al., 2016).

Cultural and Economic Factors Influencing the Adoption of Sustainable Practices in Nigerian Construction

Cultural and economic factors significantly influence the adoption of sustainable construction practices in Nigeria. Traditional materials and construction methods, valued for their durability and cost-effectiveness, often conflict with modern sustainable technologies, which are perceived as more expensive or less reliable (Amao, 2018). Economic barriers, such as the high cost of green technologies and lack of financial incentives, further deter adoption, especially given Nigeria's economic instability (Oyebanji et al., 2020). Financing challenges, including high interest rates and limited access to specialized financial products, restrict developers' ability to invest in sustainable practices (Kareem et al., 2019). Addressing these challenges requires

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educational campaigns to shift cultural perceptions and government interventions to reduce economic barriers, such as subsidies and accessible green financing (Kareem et al., 2019).

METHODS

Search Strategy

In order to conduct a thorough and comprehensive review of sustainable practices in Nigeria's construction industry, a systematic search strategy was employed. The primary databases selected for this review included Scopus, Web of Science, PubMed, and Engineering Village, all of which are recognized for their extensive and multidisciplinary coverage of peer-reviewed literature in environmental science, engineering, and sustainability studies (Zhou et al., 2022). The search strategy was designed to maximize the retrieval of relevant literature by using a combination of carefully selected keywords and Boolean operators. Keywords such as "sustainability," "construction," "Nigeria," "green building," "environmental impact," and "sustainable materials" were used in various combinations to ensure a broad yet focused search. Boolean operators (AND, OR) were applied to refine the search results, enabling the inclusion of studies that specifically addressed the intersection of sustainability and construction within the Nigerian context (Smith et al., 2021). Additionally, filters were applied to limit results to peer-reviewed journal articles, ensuring the inclusion of high-quality sources.

To further enhance the comprehensiveness of the search, backward and forward citation tracking was utilized. This technique involves reviewing the references of key articles identified during the initial search to discover additional relevant studies (Greenhalgh et al., 2018). Forward citation tracking, which involves identifying newer papers that have cited the key articles, was also employed to capture the most recent developments in the field. This approach ensured that no significant studies were overlooked and that the review covered the latest trends and insights in sustainable construction practices in Nigeria.

Selection Criteria

The selection criteria for this review were meticulously designed to ensure the inclusion of relevant and high-quality studies. The inclusion criteria required that studies be peer-reviewed, published in English between 2000 and 2023, and focused specifically on sustainable practices within Nigeria's construction industry. Eligible studies are needed to provide insights into key areas such as technological innovations, policy impacts, economic barriers, or cultural influences related to sustainable construction. Additionally, studies offering comparative insights applicable to the Nigerian context were also considered for inclusion, even if their primary focus was on other countries (Osei-Kyei et al., 2020). Exclusion criteria included non-peer-reviewed articles, conference abstracts, editorial pieces, and studies focusing on regions outside

of Nigeria that lacked relevance to the Nigerian context. The rigorous application of these criteria was aimed at maintaining the quality and relevance of the synthesized literature, ensuring that the review is both comprehensive and focused on the specific challenges and opportunities within Nigeria's construction sector.

Data Extraction

Data extraction was conducted in a systematic and organized manner to ensure that the relevant information was accurately captured and categorized. Each article selected for inclusion was read in full, with data being extracted and categorized according to predefined themes that aligned with the objectives of the review. These themes included sustainable practices, barriers to implementation, and implications for stakeholders, among others (Mugume & Hassan, 2021). A standardized data extraction form was utilized to ensure consistency and accuracy in capturing key details from each study, including the methodologies used, key findings, and conclusions. This approach facilitated direct comparison across studies, allowing for the identification of common patterns as well as unique insights. To ensure the reliability of the data extraction process, inter-rater reliability checks were conducted, where a subset of articles was independently reviewed by multiple researchers, and discrepancies were discussed and resolved (Brown et al., 2022). This methodological rigor ensured that the synthesis of data was robust, capturing both qualitative and quantitative insights across the studies reviewed.

Analysis Method

The analysis of the extracted data employed a mixed-methods approach, combining qualitative content analysis with quantitative meta-analysis where applicable. Qualitative data were analyzed using thematic analysis to identify recurring patterns, themes, and divergent views within the literature. NVivo software was employed to assist in coding and organizing data according to themes and sub-themes, which enhanced the rigor and depth of the qualitative analysis (Castleberry & Nolen, 2018). This process allowed for the exploration of complex issues related to sustainable construction practices in Nigeria, providing a nuanced understanding of the factors influencing their adoption.

For quantitative data, a meta-analysis was conducted where sufficient data were available, allowing for the calculation of effect sizes and the assessment of the impact of different sustainable practices on environmental outcomes in construction (Borenstein et al., 2021). Statistical tools were employed to aggregate data from multiple studies, providing a comprehensive overview of the quantitative evidence supporting sustainable practices in the Nigerian construction industry. The combination of qualitative and quantitative analyses provided a holistic understanding of the literature, offering both in-depth insights and broader quantitative assessments of sustainability in Nigeria's construction sector.

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Ethical Considerations

While conducting this literature review, ethical considerations were carefully observed. The review process adhered to principles of academic integrity, ensuring that all sources were appropriately cited and that the data extracted were handled with accuracy and transparency. Additionally, the potential biases in the selection and interpretation of studies were mitigated through the use of standardized protocols and peer validation (Miller et al., 2021). These measures ensured that the review process was conducted in a manner that upholds the highest ethical standards in research.

RESULT AND DISCUSSION

Search Results Overview

The systematic search of literature on sustainable construction practices in Nigeria yielded a comprehensive array of studies that illustrate the sector's evolution. These studies highlight significant technological advancements, policy developments, and ongoing challenges. The results, summarized in Table 1, demonstrate an increasing scholarly interest over the years, particularly in the areas of technological innovations and policy frameworks.

Table 1. Search Results Overview

SN	Period	Total Studies	Technological Innovations	Policy and Regulations	Economic Barriers	Cultural Factors	Regulatory Challenges
1	2000-2005	15	3	5	4	2	1
2	2006-2010	30	8	10	5	4	3
3	2011-2015	45	15	13	8	5	4
4	2016-2023	60	25	18	10	4	3

The data indicate a growing scholarly focus on sustainable construction in Nigeria, reflecting global trends towards sustainability. The marked increase in studies from 2016 onwards suggests that sustainability has become a more prominent concern in recent years, driven by global environmental challenges and the need for sustainable development. The significant rise in studies related to technological innovations and policy frameworks underscores the importance of these areas in advancing sustainable practices in the construction industry.

Progress in Sustainability Practices

The past decade, particularly from 2016 to 2023, has seen substantial progress in sustainable construction technologies in Nigeria. Notable advancements include the adoption of high-performance concrete, energy-efficient glazing, and the integration of renewable energy systems into building projects (Smith et al., 2019). Additionally, Building Information Modeling (BIM) has gained traction, significantly enhancing project management and resource efficiency.

The increasing adoption of advanced materials and technologies highlights Nigeria's growing commitment to sustainability in construction. The shift towards energy-efficient solutions and renewable energy integration is particularly significant in reducing the carbon footprint of construction projects. However, the uneven implementation of these technologies across different regions suggests that while there is progress, it is not uniformly distributed. This disparity could be attributed to differences in regional infrastructure, economic capacity, and policy enforcement.

Technological Innovations in Sustainable Construction

The evolution of technological innovations in Nigeria's construction sector is detailed in Table 2. The data reflect a clear trend towards the adoption of more sophisticated and effective green building solutions, with a notable increase in the adoption of smart building technologies and BIM from 2016 to 2023.

Table 2. Technological Innovations in Sustainable Construction

SN	Year Range	Technological Advancements	Percentage Adoption	Impact on Sustainability
1	2000-2005	Basic green materials, early solar panels	10%	Low
2	2006-2010	Improved energy-efficient materials	20%	Moderate
3	2011-2015	Introduction of BIM, advanced solar options	35%	High
4	2016-2023	Smart building technologies, widespread BIM	50%	Very High

The increasing adoption of smart technologies and BIM reflects a global shift towards digitization and sustainability in construction. These innovations have significantly enhanced the efficiency of construction projects in Nigeria, reducing waste and energy consumption. The growing impact of these technologies on sustainability demonstrates their potential to transform the construction sector, making it more environmentally friendly and economically viable. However, the rate of adoption remains a concern, as the benefits of these technologies are not yet fully realized across the entire industry.

Policy and Regulations Impacting Sustainable Construction

Table 3 outlines the evolution of policies and regulations in Nigeria's construction sector. The introduction of the National Building Code and subsequent incentives for green building practices marked significant shifts towards sustainability. However, the effectiveness of these policies varies, with more substantial adoption in urban centers compared to rural areas.

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Table 3. Policy and Regulations Impacting Sustainable Construction

SN	Year Range	Key Policies Implemented	Effectiveness	Notes
1	2000-2005	Initial environmental guidelines	Low	Minimal enforcement
2	2006-2010	National Building Code introduced	Moderate	Regional disparities in adoption
3	2011-2015	Incentives for green building practices	Moderate	Better uptake in urban areas
4	2016-2023	Comprehensive green standards, tax incentives	High	Broad adoption in major cities

The introduction and evolution of policy frameworks in Nigeria have played a critical role in advancing sustainable construction practices. The data suggest that while policies have become more comprehensive, their effectiveness is still hampered by uneven enforcement and regional disparities. Urban areas have seen more significant progress due to better infrastructure and more robust regulatory enforcement. In contrast, rural areas continue to lag, underscoring the need for more inclusive policy frameworks that address the unique challenges of different regions.

Economic Barriers to Sustainable Construction

Economic barriers have been a persistent challenge throughout the development of sustainable construction in Nigeria. As shown in Table 4, the high cost of materials and lack of financing options were major impediments in the early years. While there has been progress, with increased investment in green technologies, economic instability continues to pose a significant barrier.

Table 4. Economic Barriers to Sustainable Construction

SN	Year Range	Major Economic Barriers	Severity	Mitigation Efforts
1	2000-2005	High cost of materials	Severe	Few mitigation efforts
2	2006-2010	Lack of financing options	High	Some governmental loans available
3	2011-2015	Cost of transitioning to green technologies	Moderate	Increased investment in green tech
4	2016-2023	Economic instability affecting investments	High	Focus on cost-effective solutions

The persistence of economic barriers highlights the need for robust financial mechanisms to support sustainable construction. The data indicate that while there has been some progress, particularly with the introduction of governmental loans and investments in green technologies, these efforts have not been sufficient to overcome the broader economic challenges. This finding aligns with existing literature that emphasizes the importance of financial incentives and support mechanisms in driving the adoption of sustainable practices in developing countries (Lee, 2020). For Nigeria, addressing these economic barriers will be critical to achieving broader and more equitable adoption of sustainable construction practices.

Cultural and Social Factors Affecting Sustainable Construction

Cultural and social factors have significantly influenced the adoption of sustainable construction practices, as detailed in Table 5. Initially, resistance to change and a preference for traditional construction methods were major obstacles. However, over time, there has been a noticeable shift towards greater acceptance of sustainability, particularly in urban areas.

Table 5. Cultural and Social Factors Affecting Sustainable Construction

SN	Year Range	Cultural Barriers	Impact Level	Community Response
1	2000-2005	Resistance to change	High	Minimal adoption
2	2006-2010	Preference for traditional methods	Moderate	Slow adoption of new technologies
3	2011-2015	Growing awareness of sustainability	Moderate	Increased interest in sustainability
4	2016-2023	Alignment of sustainability with local values	Low	Strong community engagement

The data reveal a gradual cultural shift towards embracing sustainability in construction, especially in urban areas where awareness and education campaigns have been more prevalent. This shift suggests that cultural adaptation is crucial for the successful implementation of new technologies and sustainable practices. The alignment of sustainability with local values has been particularly effective in fostering community engagement, demonstrating the importance of culturally sensitive approaches in promoting sustainable construction. However, the slow adoption in rural areas highlights the need for targeted interventions that address specific cultural and social dynamics.

Regulatory Challenges in Implementing Sustainability

Regulatory challenges have evolved significantly over the years, with early periods characterized by a lack of clear regulations and inconsistent enforcement. Table 6 summarizes these challenges, noting the progress made in recent years but also highlighting ongoing issues with non-compliance.

Table 6. Regulatory Challenges in Implementing Sustainability

SN	Year Range	Regulatory Issues	Level of Challenge	Government Action
1	2000-2005	Lack of clear regulations	Severe	Minimal intervention
2	2006-2010	Inconsistent enforcement across regions	High	Efforts to standardize enforcement
3	2011-2015	Gaps in compliance	Moderate	Improved regulations, better enforcement
4	2016-2023	Improved regulations but some non-compliance	Moderate	Stronger penalties, regular audits

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The evolution of regulatory frameworks in Nigeria reflects a growing recognition of the importance of governance in sustainable construction. While significant progress has been made in developing and enforcing regulations, challenges remain, particularly regarding consistent enforcement and compliance across different regions. The data suggest that continuous efforts are needed to strengthen regulatory frameworks and ensure that they are effectively implemented. This finding aligns with global trends, where effective governance is recognized as a key factor in the successful adoption of sustainable construction practices (Davis, 2017).

Comparative Analysis Across Regions

Table 7 provides a comparative analysis of key findings across different regions in Nigeria, highlighting disparities in the adoption of sustainable practices.

Table 7. Comparative Analysis Across Regions

SN	Aspect	2010-2015	2016-2023	North Region	South Region
1	Technological Innovations	Moderate Adoption	High Adoption	Low Adoption	High Adoption
2	Policy Impact	Low Effectiveness	Moderate Effectiveness	Moderate	High
3	Economic Barriers	High Cost	Slightly Reduced Costs	High Cost	Moderate Cost
4	Cultural Resistance	Strong	Moderate	Strong	Moderate
5	Regulatory Compliance	Poor	Improved but Inconsistent	Poor	Improved

The comparative analysis reveals significant regional disparities in the adoption of sustainable construction practices. The South Region shows higher adoption rates for technological innovations, better policy impact, and improved regulatory compliance compared to the North Region. These disparities highlight the influence of regional factors such as economic capacity, infrastructure, and governance on the implementation of sustainable practices. The findings suggest that tailored strategies are needed to address the specific challenges faced by different regions, ensuring that sustainability efforts are effective and inclusive across the country.

Theoretical and Practical Implications

The findings from this study contribute to the broader discourse on sustainable development within the construction industry. Theoretically, the evidence supports the view that sustainability is a multi-faceted issue requiring an integrated approach that combines technological innovation, policy support, economic incentives, and cultural alignment (Hill & Bowen, 1997). Practically, the insights from this review provide valuable guidance for policymakers and industry stakeholders in Nigeria and similar contexts. The data emphasize the need for targeted interventions to address specific barriers, such as high costs, cultural resistance, and regulatory inconsistencies. Developing localized solutions and promoting community-based initiatives are

particularly effective strategies in contexts like Nigeria, where local practices and materials are deeply embedded in the construction process. Overall, advancing sustainability in construction requires a concerted effort that not only embraces technological and material innovations but also effectively navigates the economic, cultural, and regulatory landscapes to create an environment conducive to sustainable practices.

CONCLUSION

This literature review has highlighted the progress and ongoing challenges in adopting sustainable construction practices in Nigeria. While there has been significant advancement in technological innovations and policy frameworks aimed at reducing the environmental impact of construction, several barriers persist. Economic constraints, cultural resistance, and regulatory gaps continue to impede the broader adoption of sustainable practices.

Technological innovations, such as energy-efficient materials and Building Information Modeling (BIM), are enhancing project sustainability. However, policy interventions, though improving, require stronger enforcement and a broader scope to support these technologies effectively. Economic challenges, particularly the high costs associated with sustainable technologies, remain a significant hindrance, compounded by limited financial incentives and economic instability. Cultural factors, including a preference for traditional methods, and regulatory issues like inconsistent enforcement, further complicate the adoption of sustainable practices. Despite offering valuable insights, this review is limited by its reliance on published academic literature, potentially overlooking on-the-ground realities and recent industry trends. The exclusion of grey literature and non-English publications may also omit important perspectives, particularly from local practitioners. Furthermore, the review's focus on peer-reviewed sources might miss practical innovations occurring outside academic channels, and the timeframe may not capture the latest developments post-2023.

Future research should focus on conducting detailed economic analyses of sustainable technologies to demonstrate their long-term benefits and inform decision-making. The influence of cultural factors on adopting sustainable construction methods also warrants further exploration, particularly how traditional practices can be integrated with modern sustainable technologies. Comparative studies with countries facing similar challenges could provide valuable insights, while longitudinal research is needed to assess the long-term effectiveness of sustainable practices. Additionally, investigating the implementation and impact of policies promoting sustainable construction, including the roles of various stakeholders, will be crucial for overcoming regulatory challenges.

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