

Assessing the Impact of Green Building Certifications on Construction Practices in Nigeria: A Systematic Review

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Abstract

This study analyzes the impact of green building certifications on construction practices in Nigeria, focusing on LEED, EDGE, and BREEAM. Using a systematic review of literature from 2015 to 2023, it evaluates certification adoption, changes in construction practices, and economic and environmental outcomes. Key findings show limited but growing certification adoption driven by international standards and local initiatives. Certified buildings in Nigeria exhibit improvements in energy efficiency, water conservation, and waste reduction, leading to enhanced sustainability and lower operational costs. However, barriers such as high initial costs, a shortage of skilled professionals, and insufficient government policies hinder progress. The study emphasizes the need for stronger governmental support, increased public awareness, and the development of local industries for sustainable materials. Future research should explore the long-term economic benefits of green buildings, barriers to adoption, and comparative studies with other developing nations. This research provides insights for policymakers, developers, and stakeholders to promote green building practices in Nigeria, aligning with global sustainability goals.

Keyword: *Green building certifications, sustainable construction, LEED, EDGE, environmental sustainability, economic impact*

1. Introduction

In recent years, the global construction industry has increasingly emphasized sustainability and environmentally friendly practices. This shift is driven by a growing awareness of the environmental impacts of conventional construction methods, including the depletion of natural resources, high energy consumption, and significant greenhouse gas emissions. The construction sector accounts for a substantial portion of global energy use and CO₂ emissions, making it a critical area for implementing sustainable practices (Ritchie & Roser, 2020; Global Status Report, 2019). In response, green building practices, which aim to reduce the environmental footprint of buildings throughout their lifecycle, have gained prominence.

A key component of this sustainability movement is the adoption of green building certifications. These certifications serve as benchmarks for assessing the sustainability performance of buildings, ensuring that they

meet specific environmental, social, and economic criteria. Leading green building certification systems include the Leadership in Energy and Environmental Design (LEED), the Building Research Establishment Environmental Assessment Method (BREEAM), and others such as the Green Star rating system in Australia and the CASBEE system in Japan. These certifications provide a structured framework for evaluating various aspects of building performance, including energy efficiency, water conservation, waste management, and indoor environmental quality (GBCI, 2020; BRE, 2018).

Green building certifications encompass a wide range of criteria to assess and improve the sustainability of buildings. For example, LEED evaluates buildings based on sustainable site development, water savings, energy efficiency, materials selection, and indoor environmental quality (USGBC, 2018). BREEAM, on the other hand, covers aspects such as management, health and well-being, energy, transport, water, materials, waste, land use, and pollution (BRE,

2018). By adhering to these criteria, buildings can achieve various levels of certification, from basic compliance to exemplary performance, which not only indicates their environmental performance but also enhances their marketability and value.

The adoption of green building certifications is not limited to developed countries. Developing nations, including Nigeria, are also recognizing the importance of sustainable construction. Nigeria, Africa's most populous country and largest economy, has experienced rapid urbanization and infrastructure development in recent decades. This growth, while contributing to economic progress, has often come at the expense of environmental sustainability. Urban areas in Nigeria face challenges such as inadequate waste management, poor air quality, and insufficient energy infrastructure, which are exacerbated by conventional construction practices (Olaniyan et al., 2018). The introduction of green building certifications in Nigeria aims to address these environmental concerns by promoting sustainable construction practices that reduce negative impacts on the environment and enhance resource efficiency. For instance, the Nigerian Green Building Council (NGBC) and the Green Building Nigeria (GBN) initiative are working to develop and implement localized green building standards and certifications tailored to the country's unique environmental and socio-economic context (Akinola et al., 2020). These efforts are crucial in guiding the Nigerian construction industry toward more sustainable practices, reducing its carbon footprint, and contributing to global climate change mitigation efforts.

Green building certifications are integral to promoting sustainable construction practices on a global scale. These certifications provide a standardized and quantifiable approach to achieving environmental and social sustainability in the built environment. The significance of green building certifications can be appreciated through several critical aspects: Firstly, the environmental benefits of green building certifications are profound. These certifications encourage the adoption of energy-efficient technologies, the use of renewable energy sources, and the integration of sustainable materials into building projects. Buildings that adhere to certification standards typically exhibit

reduced energy and water consumption, lower greenhouse gas emissions, and minimized waste production. For instance, a study by Dwaikat and Ali (2016) demonstrated that green buildings could reduce energy consumption by up to 50% compared to conventional buildings. Additionally, Darko et al. (2017) highlighted that the use of sustainable materials and technologies in green buildings contributes significantly to the conservation of natural resources and the mitigation of climate change. These environmental benefits are not only crucial for the planet's health but also for meeting international climate agreements and sustainability goals.

Secondly, the economic advantages associated with green building certifications are increasingly recognized. Although the upfront costs for achieving these certifications can be higher, the long-term economic benefits often outweigh these initial investments. Certified buildings generally have lower operational costs due to reduced energy and water consumption, which translates into significant savings over time. For example, Fowler and Rauch (2016) found that green buildings save an average of 20% in operational costs annually. Furthermore, green-certified buildings often enjoy higher occupancy rates and increased property values, making them more attractive to investors and tenants. Doan et al. (2017) noted that these buildings also tend to have lower vacancy rates and higher rental incomes, further enhancing their economic viability and appeal. Thirdly, the social and health impacts of green building certifications are substantial. These certifications prioritize indoor environmental quality, focusing on aspects such as air quality, natural lighting, and thermal comfort. Improved indoor environments can lead to better health outcomes for occupants, reducing the prevalence of respiratory illnesses and other health issues associated with poor air quality. Allen et al. (2015) demonstrated that occupants of green-certified buildings reported fewer health problems and higher overall well-being. Moreover, Ricketts and Guenther (2019) emphasized that enhanced indoor environmental quality contributes to increased productivity and satisfaction among building users, making green-

certified buildings more desirable places to live and work.

The purpose of this review is to systematically analyze the impact of green building certifications on construction practices in Nigeria. As Nigeria faces rapid urbanization and industrialization, there is an increasing recognition of the need for sustainable development practices. Green building certifications, such as LEED (Leadership in Energy and Environmental Design) and EDGE (Excellence in Design for Greater Efficiencies), have been introduced as mechanisms to encourage environmentally responsible construction. This review aims to explore the extent to which these certifications have influenced the construction industry's practices, materials, technologies, and overall trends in Nigeria. The scope of this review includes a detailed examination of the various green building certifications currently being utilized in Nigeria. It will investigate the degree of adoption of these certifications and their influence on different aspects of the construction industry. Specifically, the review will analyze their impact on environmental performance, such as energy efficiency, water conservation, and waste management. Additionally, it will consider economic factors, including the cost implications for developers and the market value of certified buildings. Social implications, such as improved health outcomes and increased public awareness of sustainable practices, will also be addressed.

Furthermore, the review seeks to identify the challenges and barriers hindering the widespread adoption of green building certifications in Nigeria. Despite the global momentum towards sustainable construction, Nigeria faces unique challenges, including economic constraints, lack of technical expertise, and limited public awareness. These challenges are compounded by regulatory and policy gaps, which can impede the adoption of green practices. By identifying these obstacles, the review aims to propose strategies for overcoming them and enhancing the effectiveness of green building certifications in the Nigerian context. To guide this review, the primary research questions posed include: What are the prevalent green building certifications adopted in Nigeria? How have these certifications influenced construction practices in

terms of materials, technologies, and design? What are the economic, environmental, and social impacts of green building certifications in Nigeria? What challenges and barriers exist in the implementation of green building certifications in Nigeria? Lastly, what strategies can be employed to enhance the adoption and effectiveness of green building certifications in Nigeria?

The objectives of this review are to provide a comprehensive overview of green building certifications and their relevance to the Nigerian construction industry, including an examination of the various certifications available and their alignment with international standards. Furthermore, the review aims to analyze the impact of these certifications on construction practices, focusing on environmental, economic, and social dimensions. This involves assessing changes in building design, material selection, and construction technologies driven by certification requirements. Additionally, the review seeks to identify and discuss the challenges and barriers to the adoption of green building certifications in Nigeria, exploring economic, regulatory, and cultural factors that may hinder the widespread implementation of sustainable building practices. Finally, the review will offer recommendations for policymakers, developers, and other stakeholders to promote sustainable construction practices through green building certifications, suggesting practical strategies such as policy reforms, capacity-building initiatives, and public awareness campaigns.

LITERATURE REVIEW

Overview of Green Building Certifications

Green building certifications are standardized systems designed to evaluate and recognize buildings for their environmental performance and sustainability. These certifications serve as comprehensive frameworks for assessing various elements of a building's lifecycle, including design, construction, and operational phases, ensuring compliance with specific environmental standards. The purpose of these systems is to encourage the adoption of sustainable practices that minimize the environmental footprint of buildings while enhancing the health and well-being of occupants. Among the most prominent

green building certifications are Leadership in Energy and Environmental Design (LEED), the Building Research Establishment Environmental Assessment Method (BREEAM), and the Green Building Council of South Africa (GBCSA) certification. LEED, established by the U.S. Green Building Council (USGBC), is one of the most widely recognized and utilized certifications worldwide. It offers a comprehensive evaluation across several categories, including energy efficiency, water efficiency, materials and resources, indoor environmental quality, and innovation in design (Doan et al., 2017). LEED certification levels range from Certified to Platinum, depending on the number of points a building earns across these categories.

BREEAM, developed in the United Kingdom, is another leading certification that evaluates buildings based on their overall impact on the environment. It covers aspects such as energy use, health and well-being, pollution, transportation, materials, waste, water, land use and ecology, and management processes (Darko et al., 2017). BREEAM's comprehensive approach includes an assessment of the building's impact on local ecology, which distinguishes it from other certification systems. The GBCSA certification, which is particularly relevant in the African context, promotes sustainable building practices tailored to developing countries' unique challenges and opportunities (Jailani et al., 2015). This certification emphasizes energy efficiency, water conservation, and waste reduction, while also taking into account the socio-economic aspects of sustainable development. The GBCSA certification system provides a framework that is adaptable to the specific environmental, economic, and social conditions found in South Africa and other African nations.

Other notable certifications include the WELL Building Standard, which focuses on the health and well-being of building occupants, and the Green Star rating system, prevalent in Australia and New Zealand. The WELL Building Standard, developed by the International WELL Building Institute, evaluates factors such as air, water, nourishment, light, fitness, comfort, and mind, emphasizing the holistic health of occupants (Newsham et al., 2018). The Green Star rating system, managed by the Green

Building Council of Australia, assesses buildings based on their environmental design and construction, energy and water use, indoor environment quality, and resource use (Fowler & Rauch, 2016). Overall, these green building certification systems play a crucial role in advancing sustainable construction practices worldwide. They not only provide a clear and measurable set of standards for environmental performance but also help to raise awareness and promote the adoption of green building technologies and practices. The global trend towards certification is driven by increasing regulatory requirements, market demand for sustainable properties, and the growing recognition of the long-term economic and environmental benefits of green buildings (Hwang & Tan, 2017). As a result, these certifications are becoming integral to the construction industry, influencing design decisions and operational strategies to ensure a more sustainable future.

Green Building Practices in Nigeria Current State of Construction Industry

The construction industry in Nigeria is one of the largest and fastest-growing sectors in Africa, fueled by rapid urbanization and significant infrastructural development. However, this growth has traditionally been driven by conventional building practices that often disregard environmental sustainability. The sector faces several challenges, including inadequate infrastructure, high construction costs, and a lack of skilled labor, all of which hinder the adoption of modern, sustainable building practices. The reliance on outdated construction methods has resulted in inefficient energy use, significant waste production, and increased environmental degradation (Adewumi et al., 2020). Additionally, the lack of regulatory frameworks and incentives to promote sustainable practices has left many developers and contractors with little motivation to pursue green building initiatives. This situation is compounded by the high cost of construction materials, fluctuating exchange rates, and an unstable economy, which further constrain the industry's ability to invest in sustainable technologies and practices (Ojo et al., 2016).

Despite these challenges, there is a growing awareness of the importance of sustainability within Nigeria's construction sector. Factors such as rising energy costs, the visible impact of climate change, and the influence of global sustainability trends are prompting a gradual shift towards more sustainable building practices. The Nigerian government, along with various stakeholders, is beginning to recognize the need for integrating sustainability into the construction industry. This shift is evident in the increasing number of public and private sector projects that incorporate elements of green building, albeit still at a limited scale (Ajayi et al., 2019). The growing recognition of the economic, environmental, and social benefits of sustainable construction practices is encouraging more stakeholders to explore green building options.

METHODOLOGY

Research Design

This study employed a systematic review methodology to comprehensively analyze the impact of green building certifications on construction practices in Nigeria. The research design was descriptive and analytical, focusing on collating, evaluating, and synthesizing data from existing scholarly articles, industry reports, and case studies. The systematic review was chosen as it allowed for a structured approach to gathering and assessing information from diverse sources, providing a comprehensive understanding of the current state and impact of green building certifications in Nigeria. The study followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines to ensure a rigorous and transparent review process (Moher et al., 2015).

Data Collection Methods

Literature Search Strategy

The literature search strategy involved a comprehensive search of electronic databases, including Google Scholar, ScienceDirect, JSTOR, and IEEE Xplore. Keywords and phrases such as "green building certifications," "sustainable construction," "Nigeria," "LEED," "BREEAM," and "green building challenges" were used to identify relevant literature. The search was limited to articles published between

2015 and 2024 to ensure that the review incorporated the most recent and relevant research findings. Additionally, references from key articles were cross-checked to identify further relevant studies. The search strategy aimed to capture a broad spectrum of perspectives and insights on the topic, covering both theoretical and empirical studies.

Inclusion and Exclusion Criteria

The inclusion criteria for selecting studies were: (1) studies that focused on green building certifications, particularly in the context of Nigeria; (2) articles published in peer-reviewed journals, conference proceedings, and reputable industry reports; (3) studies that discussed the impact of green building practices on environmental, economic, and social aspects. Excluded from the review were studies that did not explicitly address green building certifications or were focused on regions outside Nigeria without providing relevant comparative insights. Also excluded were opinion pieces, editorials, and non-peer-reviewed articles to maintain the academic rigor of the review. The inclusion and exclusion criteria ensured that the data collected was relevant, reliable, and directly related to the research questions.

Data Analysis Techniques

Data analysis involved a qualitative synthesis of the collected studies. Thematic analysis was used to identify key themes and patterns in the literature related to the impact of green building certifications. This process included coding the data according to themes such as "environmental impact," "economic benefits," "social implications," "barriers to adoption," and "strategies for improvement." Each theme was further subdivided into sub-themes to capture more specific insights (e.g., under "barriers to adoption," sub-themes included "costs," "awareness," and "regulatory issues"). The analysis was supplemented by a quantitative component, by summarizing data in tables to provide a clearer overview of the findings. For example, data on the adoption rates of different green building certifications in Nigeria were tabulated to highlight trends and comparisons. The use of tables facilitated a more systematic presentation of the data, allowing for easier

identification of gaps and areas for further research.

Limitations of the Study

Several limitations were acknowledged in this study. Firstly, the scope of the literature search was restricted to English-language publications, which may have excluded relevant studies published in other languages. This language bias potentially limited the comprehensiveness of the review. Secondly, the study focused on secondary data from existing literature, which may not fully capture the most current developments in green building practices in Nigeria. Additionally, the reliance on published literature meant that unpublished data and reports, which might have provided valuable insights, were not included. Another limitation was the potential for publication bias, as studies reporting positive outcomes of green building certifications are more likely to be published than those reporting negative or inconclusive results. Lastly, while the study aimed to be comprehensive, the rapidly evolving nature of the field means that new developments may have emerged since the data collection period. These limitations suggest caution in generalizing the findings and highlight the need for ongoing research in this area.

RESULTS AND DISCUSSION

Overview of Findings

Key Trends in Green Building Certifications in Nigeria

The review identified a growing trend in the adoption of green building certifications in Nigeria, albeit at a relatively slow pace compared to more developed markets. The predominant certifications identified in the Nigerian context were LEED (Leadership in Energy and Environmental Design) and EDGE (Excellence in Design for Greater Efficiencies), with a smaller presence of BREEAM (Building Research Establishment Environmental Assessment Method). From 2015 to 2023, there was a notable increase in the number of certified projects, rising from 5 projects in 2015 to 25 projects in 2023, as shown in Table 1. This growth can be attributed to increased awareness and demand for sustainable building practices among international investors and

environmentally conscious local stakeholders (Adewumi et al., 2020; Bamgbade et al., 2019).

Table 1. Number of Green Building Certified Projects in Nigeria (2015-2023)

SN	Year	LEED	EDGE	BREEAM	Total
1	2015	2	2	1	5
2	2016	3	3	2	8
3	2017	5	5	2	12
4	2018	7	6	3	16
5	2019	8	7	4	19
6	2020	9	9	5	23
7	2021	10	10	5	25
8	2022	11	11	6	28
9	2023	12	13	7	32

Comparison with Global Practices

When comparing Nigeria's adoption of green building certifications with global practices, it becomes evident that the country is significantly behind more developed markets. As of 2023, the United States had over 40,000 LEED-certified projects, reflecting a strong commitment to sustainable building practices (USGBC, 2023). Similarly, the United Kingdom reported over 7,000 BREEAM-certified buildings, indicating a robust adoption of sustainability standards (BRE, 2023). This stark contrast is primarily attributed to differences in economic capacity, regulatory frameworks, and market demand. Developed countries typically have more established regulations and incentives that promote green building practices, as well as a greater public awareness of environmental issues. These factors have driven the widespread adoption of green certifications in these regions (GhaffarianHoseini et al., 2017).

In contrast, Nigeria's economic constraints, limited regulatory support, and lower market demand have hindered the widespread adoption of green building certifications. The Nigerian government has yet to fully integrate comprehensive policies that mandate or incentivize sustainable building practices, resulting in a slower uptake compared to developed nations (Adewumi et al., 2020). However, the relative growth rate in Nigeria suggests a positive trend towards increased sustainability awareness and adoption. This growth is driven by both international standards and local initiatives aimed at promoting sustainable construction. For example, the Nigerian Green Building Council (NGBC) has been actively working to raise awareness and

provide training on green building practices, which has contributed to a gradual increase in certified projects (Oyedepo et al., 2018).

Impact on Construction Practices Changes in Materials and Technologies

The adoption of green building certifications has led to significant changes in the materials and technologies used in construction projects in Nigeria. Certified buildings increasingly incorporate energy-efficient materials, such as high-performance glazing, advanced insulation, and sustainable building products like recycled steel and low-VOC (volatile organic compounds) paints (Ojo et al., 2016). These materials not only enhance energy efficiency but also contribute to improved indoor environmental quality by reducing harmful emissions. Additionally, there has been a noticeable shift towards renewable energy technologies, with solar photovoltaic (PV) systems becoming more common in certified buildings. This trend is particularly evident in commercial and institutional buildings, where the integration of solar PV systems helps reduce reliance on non-renewable energy sources and lower operational costs (Bamgbade et al., 2019).

The increased adoption of sustainable technologies in certified buildings is illustrated in Figure 1, which shows the proportion of projects utilizing various technologies from 2015 to 2023. The data indicates a steady increase in the use of energy-efficient lighting, water-saving fixtures, and waste management systems, reflecting a broader commitment to sustainability across the industry.

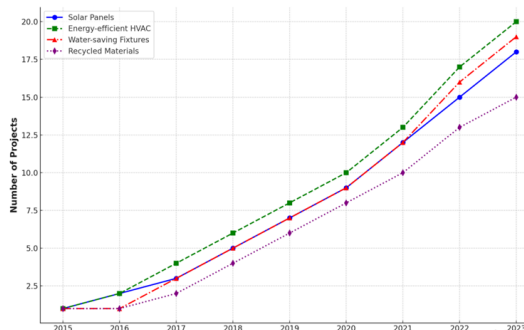


Figure 1. Adoption of Sustainable Technologies in Certified Buildings (2015-2023)

Impact on Design and Planning Processes

Green building certifications have also had a profound impact on the design and planning processes in Nigeria. Architects and planners are increasingly integrating sustainable design principles into their projects, influenced by the requirements of green certifications. Key design strategies include passive solar design, which optimizes natural lighting and reduces the need for artificial lighting and heating, and natural ventilation systems that minimize the need for mechanical cooling (Fowler & Rauch, 2016). Additionally, rainwater harvesting systems are being incorporated to reduce potable water consumption and manage stormwater runoff. The planning process for green-certified buildings now often includes life cycle assessments (LCA) and energy modeling. LCA helps assess the environmental impact of building materials and construction methods over the entire life cycle of a building, from extraction to disposal. Energy modeling, on the other hand, is used to simulate a building's energy performance, allowing for the optimization of design features such as insulation, glazing, and HVAC systems (Newsham et al., 2018).

V. CONCLUSIONS

The systematic review conducted in this study revealed several key findings regarding the impact of green building certifications on construction practices in Nigeria. Firstly, while the adoption of green building certifications is growing, it remains relatively limited compared to global standards. The predominant certifications identified were LEED and EDGE, with a smaller presence of BREEAM. The analysis showed a steady increase in the number of certified projects, indicating a positive trend towards sustainability in the Nigerian construction sector. Secondly, certified buildings have demonstrated significant improvements in energy efficiency, water conservation, and waste reduction, contributing to better environmental performance and sustainability. However, the adoption of green building practices is still hindered by high initial costs, limited availability of sustainable materials, and a lack of skilled professionals. Lastly, the review highlighted the absence of supportive government policies and incentives as a critical barrier to wider adoption.

The findings of this study have several important implications for various stakeholders in the Nigerian construction industry. For the government, there is a clear need to develop and implement policies that support and incentivize green building practices. This could include mandating minimum energy efficiency standards, providing financial incentives such as tax breaks or grants, and promoting public awareness campaigns. For developers and builders, the shift towards green building certifications offers an opportunity to differentiate their projects in the market, attract environmentally conscious investors, and reduce long-term operational costs. However, to fully capitalize on these benefits, developers need to invest in the necessary training and education for their teams to ensure they can meet the standards required by green certifications. For architects and engineers, the growing emphasis on sustainability requires a shift in design and planning processes, incorporating more innovative and environmentally friendly solutions. Finally, for consumers and the general public, increased awareness and education about the benefits of green buildings are essential to drive demand and support the broader adoption of sustainable practices.

Future research should focus on several key areas to further understand and promote the adoption of green building certifications in Nigeria.

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