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ARTICLE

Assessment of the Applicability of Green Building Rating System in Mitigating Impacts of Building Projects

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ABSTRACT

The study examined Green Building Rating System (GBRS) in use for building projects in Lagos State, Nigeria. The data for the study were collected from primary and secondary sources on the strengths and weaknesses, criteria of assessment, and the required criteria for enhancing their applicability to the Nigerian local context from the identified twelve (12) certified green building projects. Out of eighteen (18) green building experts identified in the study area, thirteen (13) participated in the study. The data obtained were analysed using thematic analysis, priority ranking and fraction method. The results showed that the most prevalent GBRS in use in the study area were Excellence in Design for Greater Efficiencies (EDGE) and Leadership in Energy and Environmental Design (LEED). Limitation in the adoption of the EDGE and LEED was their lack of functionality in the social aspects of sustainability in buildings. The study developed a weighting framework and flowchart representation of the criteria to be considered by the green building experts to enhance applicability of the rating systems. The study concluded that the EDGE and LEED adopted in the study area focused exclusively on the environmental aspects of sustainability that would mitigate impacts of

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buildings but they should be adapted to include social and economic aspects of sustainability so as to improve their usage in assessing and certifying buildings while the Nigerian government should equally make efforts to develop her own home-grown green building rating system so as to deepen applicability of GBRS in the country.

Keywords: EDGE; LEED; GBRS; Nigeria

1. Introduction

On a global scale, the construction industry accounts for approximately 40% of total energy consumption, 12–16% of available water resources, 32% of both renewable and non-renewable resource usage, and 40% of all raw material use. Additionally, it consumes 25% of global timber, is responsible for 35–40% of carbon dioxide (CO_2) emissions, and generates 30–40% of solid waste [1]. Green building has emerged as a viable strategy for promoting sustainability in the built environment. It offers a practical approach to mitigating the negative impacts of conventional buildings on the natural environment, human health, and resource consumption. By integrating environmentally responsible and resource-efficient practices throughout a building's lifecycle, green buildings contribute to a reduction in carbon emissions, improved indoor environmental quality, and optimized energy and water use. To objectively assess the performance and sustainability credentials of these buildings, various green building rating systems—such as LEED, Building Research Establishment Environmental Assessment Method (BREEAM), and Green Star—are employed [2].

There is no universally agreed-upon definition of a green building, largely due to the dynamic and evolving nature of sustainable design practices. However, several broadly accepted definitions emphasize common principles. A green building may take any form—residential, educational, commercial, healthcare, or recreational—so long as it integrates key sustainability features. These features typically include energy and water efficiency, the use of sustainable materials, indoor environmental quality, and minimal environmental impact throughout the building's life cycle. According to Kriss [3], a green building is any structure that is designed, constructed, renovated, operated, or repurposed in an environmentally responsible and resource-efficient manner.

Green building integrates a variety of sustainable features aimed at minimizing environmental impact and enhancing occupant well-being. These features include efficient water-use systems, energy conservation strategies, the incorporation of renewable energy sources, and the use of recycled or recyclable materials. In addition, green buildings emphasize site sustainability, effective building management practices, and the provision of high indoor environmental quality to support the health and comfort of occupants [4].

Ola and Adjekophori [5] further elaborated on the components of green buildings, emphasizing efficient energy use and the adoption of clean energy sources as core principles. Their definition also highlights the use of environmentally friendly building materials and design specifications, the maintenance of high indoor air quality, the reduction of toxic waste, and the application of smart development strategies. These strategies include growth and conservation approaches that not only protect the natural environment but also enhance community aesthetics, promote social diversity, and contribute to stronger local economies. Given the increasing importance of sustainable development, there is a growing need to assess the existing stock of green buildings globally. In response, many countries have developed their own Green Building Rating Systems (GBRS) to establish standards for green building design, material selection, and construction practices. These systems serve as frameworks to guide the planning, execution, and operation of buildings in alignment with sustainability principles endorsed by the World Green Building Council (WGBC) [6].

Also, Marchi et al. [7] defined GBRS as a voluntary and market driven-standard that measures buildings' sustainability by multi-criteria assessment, and encourage implementation of environmentally, economically and socially sustainable practices in the design, construction and operation of buildings or environment. The popular emergence of green buildings in the late 19th century was spurred by various concerns regarding the sustainability and environmental impact of buildings. This rising popularity informed the built industry in the early 1990s of the necessity to systematically assess and hence, rate these buildings through sets of proven criteria, which then gave rise to the development of various GBRS all around the world [8]. In response to the growing emphasis on sustainable construction, the United States established the U.S. Green Building Council (USGBC) in 1993, with the mandate to promote sustainability in the design, construction, and operation of buildings [9].

The Leadership in Energy and Environmental Design (LEED) system, developed by the USGBC, has achieved significant success and widespread adoption. Over time, it has evolved into a comprehensive framework encompassing a full set of criteria that extend beyond the design phase to include building operation, maintenance, innovation, and social dimensions of sustainability [10].

Since the inception of early rating systems like BREEAM and LEED, numerous other Green Building Rating Systems (GBRS) have been developed across the globe to address region-specific sustainability priorities. These include the Building Environmental Assessment Method (BEAM) in Hong Kong, Green Star in Australia, Alta Qualidade Ambiental (AQUA) in Brazil, the Green Building Assessment System (GBAS) in China, Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB) in Germany, PromisE in Finland, Minergie in Switzerland, Leadership in Environment and Energy Design for Sustainable Architecture (LiderA) in Portugal, Estidama in the United Arab Emirates, Valoración de Eficiencia de Referencia de Edificios (VERDE) (Spanish Building Sustainability Rating System) in Spain, the Green Building Index (GBI) in Malaysia, the Green Mark (GM) in Singapore, and the Comprehensive Assessment System for Built Environment Efficiency (CASBEE) in Japan [8,11].

Although Nigeria has yet to establish its own nationally recognized Green Building Rating System (GBRS) [6], the Federal Government, through the National Environmental Standards and Regulations Enforcement Agency (NESREA), has implemented various environmental laws aimed at protecting the country's natural environment. In the absence of a domestic GBRS, Nigeria has adopted and applied several international systems, including LEED, BREEAM, and EDGE, to guide sustainable building practices within its borders [12].

It is important to note that most Green Building Rating Systems (GBRS) are developed to suit specific regional contexts and environmental priorities, and as such, they may not be fully applicable or adaptable to all geographical regions without modification [13]. These imported GBRS may primarily be effective in evaluating the physical and functional dimensions of green buildings in Nigeria; however, they often fail to adequately address local economic, environmental, and socio-cultural considerations. The weighting and relevance of assessment criteria in these systems may not align with Nigeria's unique context, as the severity and significance of sustainability indicators vary across regions. Factors such as existing building stock, cultural practices, climatic conditions, and the availability of local materials play a critical role in determining the appropriateness of any rating system [14].

Various literature has shown that Nigeria adopts Green Building Rating Systems (GBRS) from other nations in the world because they haven't developed their own GBRS. The most adopted and preferred rating systems, according to awareness studies conducted by various researchers, are LEED, BREEAM and EDGE. There have been various concerns about the adoption of these GBRS because they were not designed specifically for Nigeria, hence they do not incorporate the local context in terms of the economic, climatic, environmental and socio-cultural aspects. The local adaptation of these adopted GBRS therefore calls for the inclusion of economic, climatic, environmental, safety and security, and socio-cultural considerations into a re-weighted framework so as to enhance the use of GBRS in Nigeria and also to promote operations of the Green Building Council of Nigeria (GBCN).

Thus, the aim of the study is to assess Green Building Rating Systems (GBRS) in use in Lagos State, Nigeria, with a view to enhancing the applicability of the rating systems. The specific objectives of the study are to: examine the Green Building Rating System (GBRS) in use for building projects in Lagos State; examine the strengths and weaknesses of the Green Building Rating System in use; and develop a weighting framework of the criteria for improving the Green Building Rating System in use in the study area.

2. Review of Related Literature

2.1. Green Building Rating and Certification Systems

Green Building Rating Systems (GBRS) evaluate key sustainability attributes such as indoor environmental quality, water and energy efficiency, waste reduction, material efficiency, and the optimization of operations and maintenance. However, different rating systems place varying levels of emphasis on these attributes [15]. According to Sustainable Investment Group (SIG) [16], the top twelve GBRS are:

2.1.1. LEED

Leadership in Energy and Environmental Design (LEED), which was established in 1993, is a green building certification used majorly in the United States and in some other countries such as India and Nigeria [16]. The United States Green Building Council manages the LEED in which buildings are certified through on-site third-party validation. The four levels of certification for LEED are Platinum, Gold, Silver and Certified with its nine areas of focus on, sustainable sites, material and resources, water efficiency, location and transportation, indoor environmental quality, energy and atmosphere, regional priority, innovation, and integration [16].

2.1.2. WELL

This certification program, developed over a decade ago, is administered by the International WELL Building Institute (IWBI) [17]. WELL is a leading global initiative aimed at enhancing the health and well-being of occupants in buildings, organizations, and communities [17]. It supports both physical and mental health by evaluating buildings based on ten core concepts: air, water, light, nourishment, movement, thermal comfort, sound, mind, materials, and community [17]. Similar to LEED, WELL is applicable to a wide range of building types and spaces [16].

2.1.3. EDGE

Excellence in Design for Greater Efficiencies (EDGE) is a worldwide GBRS that was initiated in 2014 by the International Finance Corporation (IFC), which is a private sector subsidiary of the World Bank. The EDGE certification system focuses on energy, water, and embodied energy in materials as its criteria for building design and assessment. The EDGE certification procedure begins in the EDGE software. The EDGE designer creates a base case model and an improved case model for each project in the software [18].

2.1.4. Green Globes

Green Globes is an online green building rating and certification system that evolved from BREEAM and was developed by the Green Building Initiative for use in Canada. It is also utilized in the United States and is designed as a self-assessment tool for project managers and design teams [16]. Similar to Facility Innovations Toward Wellness Environment Leadership (FITWEL) and BREEAM, Green Globes does not impose mandatory prerequisites for certification [16,19]. The system is applicable to a wide range of building types and uses, including retrofits, new constructions, schools, multi-residential buildings, commercial interiors, hotels, sports facilities, warehouses, hospitals, laboratories, and industrial facilities [20].

2.1.5. BREEAM

The Building Research Establishment Environmental Assessment Method (BREEAM), developed in the United Kingdom in 1990, is recognized as the world's first sustainability assessment method for buildings. Since its inception, it has certified 594,011 building projects and registered 2,313,475 buildings across 89 countries [21]. BREEAM assessments are conducted across nine key categories: management, health and well-being, energy, transport, water, materials, waste, land use and ecology, and pollution [16]. The primary objective of BREEAM is to promote sustainable building practices by enhancing building performance, efficiency, and environmental responsibility [22].

2.1.6. DGNB

The Deutsche Gesellschaft für Nachhaltiges Bauen (DGNB) rating system was established in 2007 by the German Sustainable Building Council to promote sustainable building practices across Europe [16]. Unlike some other systems, DGNB adopts a comprehensive evaluation framework with a strong emphasis on building performance. Certification is awarded at four levels-Platinum, Gold, Silver, and Bronze—based on performance across key criteria: technical quality, socio-cultural and functional quality, ecological quality, and process quality [16].

2.1.7. Green Star

The Green Star sustainability rating system is primarily used in South Africa and Australia [16]. It encourages innovative solutions and the development of new approaches to sustainability in building projects. Green Star certifies a wide range of building types and evaluates performance based on several criteria, including energy, materials, water, emissions, indoor environmental quality, land use and ecology, and transportation. Its core objective is to guide project stakeholders in making informed decisions regarding material selection and energy efficiency [16].

2.1.8. BCA Green Mark Scheme

The BCA Green Mark Scheme was launched in 2005 by Singapore to promote the development of sustainable buildings and assess their environmental impact and performance [16,23]. The scheme evaluates projects based on several key criteria, including energy efficiency, water efficiency, environmental protection, indoor environmental quality, and innovative features [16]. BEAM Plus: The BEAM certification programme is used primarily in Hong Kong but also extends to other geographical areas such as Macau, Shenzhen, Guangzhou, Shanghai and Beijing [24]. BEAM Plus offers a complete set of performance criteria that tackles various sustainability issues relating to the planning, design, construction, commissioning, fitting out, management, operation and maintenance of a building [24]. These performance criteria focus on aspects such as "Integrated design and construction management (IDCM), Community aspects (CA), Sustainable site, Site aspects (SS, SA), Green building attributes (GBA), Management (MAN), Materials and waste aspects (MWA), Energy use (EU), Water use (WU), Health and wellbeing, Indoor/outdoor environmental quality (HWB, IEQ/OEQ), Innovations and additions (IA)" [24,25].

2.1.9. Miljöbyggnad

The Swedish term Miljöbyggnad, translated as Environmental Building in English, is a green building rating system (GBRS) developed by the Sweden Green Building Council in 2010. It applies to both new new and existing buildings, with certification awarded at three levels: Gold, Silver, and Bronze [16]. Due to Sweden's strong national policies on water use and management, water efficiency is not a focus of this system. Instead, Miljöbyggnad emphasizes other critical aspects of green building, such as material use, energy consumption, and indoor environmental quality [16].

2.2. Criteria of Green Building Rating and Certification Systems

Different green building rating systems (GBRS) apply varying criteria in their certification processes. As illustrated in **Table 1**, four commonly shared criteria across most GBRS are material efficiency, energy efficiency, indoor environmental quality, health and well-being, and water efficiency. While many rating systems also emphasize sustainable siting and innovation, in systems such as BREEAM, sustainable siting constitutes only a small component under the broader category of land use and outdoor environment [25].

Table 1. Comparing Green Building Rating Systems (GBRS) criteria.

Criteria	BREEAM	LEED	CASBEE	ASGB	BEAM	Green Star (GS)	Green Mark (GM)	Green Globes (GG)	Indian Green Building Council (IGBC)	Green Building Index (GBI)
Energy Efficiency	#	#	#	#	#	#	#	#	#	#
Water Efficiency	#	#	#	#	#	#	#	#	#	#
Material Efficiency	#	#	#	#	#	#	#	#	#	#
Indoor Environmental Quality, Health and Wellbeing	#	#	#	#	#	#	#	#	#	#
Sustainable Siting		#			#			#	#	#
Innovation	#	#		#		#			#	#
Land Use and Outdoor Environment	#		#	#		#				
Waste Management	#					#	#			#

Table 1. *Cont.*

Criteria	BREEAM	LEED	CASBEE	ASGB	BEAM	Green Star (GS)	Green Mark (GM)	Green Globes (GG)	Indian Green Building Council (IGBC)	Green Building Index (GBI)
Construction Project Management	#			#		#		#		
Transport	#					#				
Integrative Process		#			#					
Pollution	#									
Sustainable Architecture and Design									#	
Offsite Environment			#							
Climate Consideration							#			
Regional Priority		#								
Advanced Green Efforts							#			

Source: Tang et al. [8].

3. Methodology

The study was conducted in Lagos State, Nigeria, to assess the Green Building Rating Systems (GBRS) currently in use, with the aim of improving their applicability. The study population comprised green building experts involved in certified green building projects within Lagos State, identified during a pilot study. These experts were selected using the snowball sampling technique. Snowball sampling, also referred to as chain-referral sampling, is a non-probability method in which existing participants recruit additional respondents who possess specific and relevant characteristics. This approach was considered appropriate since no predefined list of green building experts exists in Lagos State.

Data for the study were obtained from both primary and secondary sources. Primary data, which provide firsthand evidence, were collected through one-on-one interviews, a qualitative research method. Secondary data were drawn from books, articles, and official statistics to complement the primary findings. The sampling frame consisted of 18 experts engaged in certified green building projects in Lagos State, including Peridot Parkland Estate, Lekki Pearl Estate, Blue Waters, Alliance Place, Cornerstone Tower, Alpha 1 Tower, Heritage Place, Nestoil Tower, The Wings Complex, Procter & Gamble Nigeria Lagos Facility, 4 Bourdillon, and MISA Building. **Table 2** presents these certified projects and their locations as identified in the pilot study.

Table 2. Green building projects in Lagos State and their locations.

S/N	Projects	Location
1.	Peridot Parkland Estate.	Ascon Road, Idale 103101, Badagry, Lagos.
2.	Lekki Pearl Estate.	Sangotedo, Lagos.
3.	Blue Waters.	Off Remi Olowude Road, 102105, Lekki Phase 1, Lagos.
4.	Alliance Place.	33A Alfred Rewane Road, Ikoyi 101233, Lagos State, Nigeria.
5.	Cornerstone Tower.	Yesuf, Abila Abiodun Oniru Road, Maroko, Lagos.
6.	Alpha 1 Tower.	Marina, Eko Atlantic City, Victoria Island, Lagos.
7.	Heritage Place.	21 Lugard Avenue, Ikoyi 106104, Lagos.
8.	Nestoil Tower.	41/42 Akin Adesola Street, Saka Tinubu Street, Victoria Island, Lagos.
9.	The Wings Complex.	Ozumba Mbadiwe Way, Victoria Island, Lagos.
10.	Procter & Gamble Nigeria Lagos Facility.	52–54 Isaac John Street, Ikeja GRA, Lagos State, Nigeria
11.	4 Bourdillon.	4, Bourdillon Road, Ikoyi, Lagos.
12.	MISA Building.	47 Glover Road, Ikoyi, Lagos, Nigeria.

Source: Author's field study, 2025.

The sample size comprised the full enumeration of experts linked to these projects, resulting in 18 respondents as shown in **Table 3**. This means the sample frame is the same as the sample size. Data analysis was carried out using appropriate methods aligned with each research objective, including thematic analysis, priority ranking, and the development of a flowchart to illustrate the sequence of steps involved in designing, analyzing, and documenting activities that promote the application of GBRS. In the analytical process, the fractional formula is used to calculate the weighting scores of the criteria and sub-criteria. The weighting scores were calculated using the fractional method. The allocated points for each criterion were based on the result of the priority ranking. The points were allocated in reverse order based on the rank of the criteria; for example, the criteria that ranked first (1) had the highest point, twelve (12), and the criteria that ranked last (12) had the lowest point, one (1). After the fractions were calculated, they were then converted to percentages by multiplying each fraction score by 100%. The fractional formula for calculating the scores is shown below.

$$W = \frac{C}{TC} \times 100\% \tag{1}$$

Where: *W* is the calculated weighting scores;

C is the point allocated for each criterion/sub criterion;

TC is the total number of points for all the criteria/sub criteria.

Table 3. Sample size for green building experts.

S/N	Projects	Acquired Certification	Number of Experts	Percentage Sampled (100%)
1.	Peridot Parkland Estate. Lekki Pearl Estate. Blue Waters. Alliance Place. Cornerstone Tower.	EDGE	13	13
2.	Alpha 1 Tower. Heritage Place. Nestoil Tower. The Wings Complex. Procter & Gamble Nigeria Lagos Facility. 4 Bourdillon. MISA Building.	LEED	5	5
	Total		18	18

Source: Author's field study, 2025.

4. Results and Discussions

This section presents the findings on the applicability of Green Building Rating Systems (GBRS) in mitigating the impacts of building projects within the study area. From the survey, eighteen (18) certified green building experts were identified across green building companies in Lagos State. Interview invitations were sent to all eighteen (18) experts, of whom thirteen (13) accepted and participated, representing a response rate of 72.2%. According to Afolabi et al. [26], a 50% response rate is considered adequate for analysis, 60% is good, and any rate above 70% is very good. Thus, the response rate achieved in this study is highly reliable for analysis.

The professional distribution of respondents comprised four (4) architects, four (4) engineers, two (2) builders, two (2) construction project managers, and one (1) building facility manager (see **Table 4**). Each interview lasted between forty-five (45) and ninety (90) min, which provided sufficient time to gather in-depth and relevant information. A similar study by Adewolu [27] also adopted interviews as a primary method, confirming their effectiveness in identifying critical criteria for developing assessment frameworks.

Table 4. Demographic profile of the respondents.

Demographic Characteristic	Frequency	Percentage (%)
Gender		
Male	11	84.6
Female	2	15.4
Total	13	100.0
Highest Academic Qualification		
HND	0	0
B. Sc	3	23.1
M. Sc	8	61.5
Ph. D	2	15.4
Total	13	100.0
Profession of Respondents		
Architecture	4	30.8
Civil Engineering	3	23.2
Building	2	15.4
Construction Project Management	2	15.4
Electrical Engineering	1	7.6
Facility Management	1	7.6
Total	13	100.0
Professional Qualification		
Nigerian Society of Engineers (NSE)	6	46.1
Nigerian Institute of Architects (NIA)	4	30.8
Nigerian Institute of Building (NIOB)	3	23.1
Total	13	100.0
Acquired Green Building Certifications		
EDGE, LEED and WELL	1	7.6
EDGE and LEED	4	30.8
EDGE only	8	61.6
Total	13	100.0
Years of Working Experience		
5 years and below	3	23.1
6–10 years	7	53.8
11 years and more	3	23.1
Total	13	100.0
No. of Green Building Projects the Respondents Have Been Involved in		
1	2	15.4
2	3	23.1
3	3	23.1
4 and above	5	38.4
Total	13	100.0

Source: Author's analysis, 2025.

Demographic analysis revealed that 84.6% of respondents were male, while 15.4% were female, indicating a gender imbalance in certified green building expertise within Lagos State. This coincides with the study of Felgueiras et al. [28], who found that men are more involved in green building construction in Nigeria.

Furthermore, 61.5% of the experts held a bachelor's degree as their highest qualification. Professionally, architects accounted for 30.8% of respondents, civil engineers for 23.2%, builders for 15.4%, with the remaining proportions distributed among other professions.

Regarding work experience, 53.8% of respondents had between six (6) and ten (10) years of professional experience, while 23.1% had more than ten (10) years. This demonstrates that the respondents possessed sufficient industry experience to contribute meaningful insights toward the study objectives.

In terms of project involvement, 15.4% of experts had participated in more than three certified green building projects, 23.1% in three projects, another 23.1% in two projects, and 38.4% in only one project (see **Table 4**). These figures highlight the relatively limited number of green building projects executed in Lagos State to date, suggesting a need for increased adoption of sustainable building practices to bridge the gap between green and conventional building projects.

4.1. Green Building Rating Systems in Use

The study examined the Green Building Rating Systems (GBRS) currently in use within the study area. Through interviews conducted with certified green building experts affiliated with green building companies in Lagos State, the research identified the GBRS applied to building projects, gathered detailed information about their use, and documented the respective certification processes for these projects. The interviews were transcribed, organized into thematic clusters, and analyzed using thematic analysis, with the results presented in **Table 5**. Findings revealed that two GBRS are currently in use in Lagos State: Excellence in Design for Greater Efficiencies (EDGE) and Leadership in Energy and Environmental Design (LEED). This confirms the work of Elnagar et al. [29], who identified LEED and EDGE as prominent green building rating systems being used in Nigeria. The specific information obtained regarding each of these rating systems is presented as follows:

Table 5. Thematic analysis of the responses of the respondents on the green building rating systems in use.

Major Theme	Sub-Theme	Respondent
The Green Building Rating System in use for building projects in Lagos State	EDGE	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
	LEED	1, 5, 7, 9, 12, 13
How the EDGE certification works	• Base case • Improved case • Instant cost estimate • Reduced carbon footprint • Software based • Utility savings	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Criteria for the EDGE certification	• Embodied energy • Energy • Water	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Characteristics of the LEED certification system	• Credits • Diversity • Points • Prerequisites	1, 5, 7, 9, 12, 13
Categories in the LEED certification system	• Energy and Atmosphere • Indoor Environmental Quality • Innovation • Location and Transport • Materials and Resources • Regional Priority • Sustainable Sites • Water Efficiency	1, 5, 7, 9, 12, 13

Source: Author's analysis, 2025.

4.2. Excellence in Design for Greater Efficiencies (EDGE)

The study found that the EDGE certification system is highly preferred in the study area due to its accessibility and cost-effectiveness. Its software platform is freely available, enabling construction professionals in Lagos State to model and analyze green building designs from the conceptual stage at minimal cost.

The thematic analysis revealed that three categories of professionals are central to the EDGE certification process: EDGE Experts, EDGE Auditors, and EDGE Trainers. EDGE Experts—also referred to as EDGE Designers—apply their sustainable design knowledge and expertise with the EDGE software to ensure that building projects meet green certification standards. Their role includes developing suitable design portfolios and advising clients and investors on the benefits of EDGE certification. Professionals in engineering, architecture, or building-related fields, who either hold higher education qualifications or possess at least three years of relevant industry experience, may be accredited by the International Finance Corporation (IFC) as EDGE Experts. Accreditation requires completion of EDGE training and passing the certification exam, which costs $100 [Respondent 2].

The EDGE certification process begins with the use of the EDGE software to create two models: a base case and an improved case. The base case is established based on prevailing building codes, conventional practices, and local data such as climate conditions, building orientation, occupancy use, construction costs, energy tariffs, CO_2 intensity of the energy grid, and survey data for baseline development. The improved case is then defined in terms of the projected savings in energy, water, and embodied energy in materials relative to the base case. Once developed, the EDGE software computes the utility savings and carbon footprint reduction achieved by the improved design.

In Lagos State, the EDGE system has been applied to several certified projects, including Peridot Parkland Estate, Lekki Pearl Estate, Blue Waters, Alliance Place, Cornerstone Tower, and Alpha 1 Tower.

4.3. Leadership in Energy and Environmental Design (LEED)

The LEED categories or criteria for assessing buildings are derived from their impact categories: Location and Transport, Sustainable Sites, Water Efficiency, Energy and Atmosphere, Materials and Resources, Indoor Environmental Quality, Innovation, and Regional Priority. In the study area, the LEED certification system has been used to assess buildings such as: Heritage Place, Nestoil Tower, The Wings Complex, Procter and Gamble, Nigeria Lagos Facility, 4 Bourdillon, and MISA Building located in the study area [Respondent 13].

LEED is a system that evaluates a wide variety of sustainability matters; it takes into account energy, indoor air quality, transportation, and site selection. LEED uses a more complex base point scale for requirements and credits. LEED adopts deeper documentation, modelling and third-party verification methods for many types of buildings.

EDGE is more interested in a standardised method to achieve a minimum of 20% savings in three core areas: energy use, water use and embodied energy in building materials. EDGE can be adapted to a specific city to fit into emerging markets that are applicable in residential and commercial buildings.

LEED works with a broad and comprehensive system, while EDGE is focused on swift, cost-effective resource efficiency. LEED in Lagos State evaluates a building's impact (site selection, local ecosystem, indoor air quality). In Lagos State, mitigating urban heat island effects, local water bodies and managing waste. This is vital and helps solve these existing issues in Lagos State. EDGE focuses on energy, water and embodied carbon. This can be helpful to Lagos State in terms of implementing rainwater harvesting systems and using solar energy to deal with frequent power outages.

LEED requires documentation and costs; it can be applicable to high-brow areas like Victoria Island, Ikoyi, Banana Island, Lekki Phase 1 and Eko Atlantic City to meet International Environmental, Social and Governance (ESG) requirements. EDGE can help for emerging markets like Ikeja and other parts of Lagos State. The cost-effective structure makes it viable for local developers and lowers utility bills.

LEED focuses on human health and the productivity of building occupants as well as good indoor ventilation. This can be helpful for Lagos State in order to achieve comfortable and healthy environments for citizens. EDGE can align with the state's goals to provide eco-friendly, low cost residential spaces that reduces carbon footprint in Lagos State.

The results of the thematic analysis are summarized in **Table 6**, with the findings categorized into key dimensions: building type/phase, environmental, social, and economic aspects. These categories are discussed in detail in the following subsections.

Table 6. Thematic analysis of the responses of the respondents to the strengths and weaknesses of the Green Building Rating Systems.

Major Theme	Sub-Theme	Respondent
Strengths of EDGE	• All building types • Building design phase • Construction cost estimate • Energy, water, embodied energy • Job opportunities • Life cycle cost • New constructions • Payback period	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Limitations of EDGE	• Economic aspect • Life cycle assessment • Retrofitting or renovation • Social aspect • Sustainable site • Waste management	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11
Strengths of LEED	• All building phases • All building types • Environmental aspect • Job opportunities • Life cycle cost • New constructions • Retrofitting or renovation	1, 5, 7, 9, 12, 13
Limitations of LEED	• Economic aspect • Location and Transport • Social aspect	1, 5, 7, 9, 12, 13

Source: Author's analysis, 2025.

4.4. Building Type

The EDGE and LEED certification systems have proven to be highly useful in certifying a range of building types within the study area, including residential, commercial/office, and industrial buildings. This applicability is evident in several notable green building projects in Lagos State.

For residential developments, examples include:

- **Peridot Parkland Estate**—A residential estate comprising single-story housing units (EDGE certified);
- **Lekki Pearl Estate**—A mixed residential estate consisting of flats, semi-detached, and fully detached housing units (EDGE certified); and
- **Blue Water Lagos**—A luxury residential development consisting of five high-rise apartment towers, each approximately 18 floors (EDGE certified).

For commercial and office buildings, examples include:

- **Cornerstone Tower**—A premium-grade office building located in Victoria Island (EDGE certified);
- **Heritage Place**—A 14-story office development in Ikoyi (LEED certified); and
- **The Wings Office Complex**—A twin 15-story luxury office tower located in Victoria Island (LEED certified).

For luxury mixed-use or high-rise residential projects, an example is:

- **4 Bourdillon**—A 25-story residential tower located in Ikoyi, comprising multiple apartment units of varying sizes (LEED certified).

For industrial facilities, an example is:

- **Procter & Gamble Lagos Facility**—An industrial complex situated in Ikeja (LEED certified).

These projects demonstrate the flexibility and applicability of both EDGE and LEED certification systems across diverse building types and phases, highlighting their role in promoting sustainable construction practices in Lagos State.

4.5. Building Phase

The interviews revealed that both EDGE and LEED certification systems perform effectively across the various phases of a building's life cycle—design, construction, operation, and end-of-life. Each system is structured with specific characteristics, criteria, and indicators that support functionality throughout these phases.

Although EDGE has some influence on the construction, operation, and end-of-life stages, its primary strength lies in the design phase. This is facilitated through the EDGE software, which allows designers to input building parameters to estimate potential reductions in energy use, water consumption, and embodied carbon footprint [Respondent 4]. The software also offers limited support during the construction phase by providing realistic cost estimates based on local data and accounting for transportation distances of materials from manufacturers to sites. During the operation phase, EDGE-certified parameters guide the monitoring of energy and water use, enabling comparisons with conventional buildings and helping to calculate the payback period for efficient technologies [Respondent 3].

In contrast, LEED demonstrates a broader and more balanced influence across all building phases—design, construction, operation, and end-of-life. This is largely due to its diverse framework of categories, prerequisites, and credits, which are integrated to ensure that each phase of a building's life cycle is systematically addressed.

4.6. Building Scope

Both the LEED and EDGE certification systems are primarily designed for certifying newly constructed buildings. The EDGE process begins at the preliminary stage, when a building is still in its planning and design phase. Final certification is granted only after construction has been completed and the building has undergone auditing. However, a major limitation of EDGE is its inability to certify existing or retrofitted buildings. This shortcoming arises because the EDGE software lacks the functionality to generate accurate data for existing structures, particularly in areas such as embodied energy [Respondent 6].

In contrast, LEED is more versatile, as it can be applied to both new constructions and existing or retrofitted buildings. Nonetheless, within the study area, this capacity has not yet been fully explored, since all known LEED-certified buildings to date are newly constructed projects.

4.7. Development of Weighting Scores

The weighting scores were derived using the fractional method (**Table 7**). In this approach, the points assigned to each criterion were determined from the results of the priority ranking provided by respondents. The allocation of points followed a reverse order system: the criterion ranked highest (1) was assigned the maximum score of twelve (12) points, while the criterion ranked lowest (12) received the minimum score of one (1) point. Once the fractional values were obtained, they were subsequently converted into percentages by multiplying each fractional score by 100%. The formula applied for calculating the fractional scores is presented below:

$$W = \frac{C}{TC} \times 100\%$$

Where: W is the calculated weighting scores;

C is the point allocated for each criterion;

TC is the total number of points for all the criteria.

$$TC = C1 + C2 + C3 + C4 + C5 + C6 + C7 + C8 + C9 + C10 + C11 + C12$$

$$TC = 12 + 11 + 10 + 9 + 8 + 7 + 6 + 5 + 4 + 3 + 2 + 1 = 78 \text{ Points}$$

Similarly, the weighting scores of the sub-criteria were calculated using the fractional method. The points allocated to each sub-criterion were determined from the results of the priority ranking, as presented in **Table 8**. The allocation followed a reverse order system: the sub-criterion ranked first (1) was assigned the highest score of five (5) points, while the sub-criterion ranked last (5) received the lowest score of one (1) point.

Table 7. Weighting scores of the assessment criteria.

S/N	Assessment Criteria	Fractions	Weighting Scores in %
1.	Energy efficiency	$\frac{12}{78}$	15.38
2.	Water efficiency	$\frac{11}{78}$	14.10
3.	Waste management, pollution and emission	$\frac{10}{78}$	12.82
4.	Climate and resilience to environmental hazards	$\frac{9}{78}$	11.54
5.	Material selection and efficiency	$\frac{8}{78}$	10.26
6.	Indoor environmental quality, health, and wellbeing	$\frac{7}{78}$	8.97
7.	Safety and security	$\frac{6}{78}$	7.69
8.	Life cycle assessment and integrative process	$\frac{5}{78}$	6.42
9.	Sustainable site, location and transportation	$\frac{4}{78}$	5.13
10.	Socio-cultural aspect	$\frac{3}{78}$	3.85
11.	Innovation, sustainable architecture and design	$\frac{2}{78}$	2.56
12.	Life cycle cost efficiency	$\frac{1}{78}$	1.28
	Total	$\frac{78}{78}$	100

Source: Author's analysis, 2025.

Table 8. Weighting scores of the assessment sub-criteria.

S/N	Assessment Sub-Criteria	Fractions	Weighting Scores in %
	Energy Efficiency		$W = (15.38)$
1.	Energy efficient technology	$\frac{5}{15}$	5.12
2.	Building orientation	$\frac{4}{15}$	4.10
3.	Passive design techniques	$\frac{3}{15}$	3.08
4.	Renewable energy technology	$\frac{2}{15}$	2.05
5.	Weatherisation	$\frac{1}{15}$	1.03
	Water Efficiency		$W = (14.10)$
1.	Potable water conservation and water use technology	$\frac{5}{15}$	4.70
2.	Water metering and leak detection	$\frac{4}{15}$	3.76
3.	Storm water and grey water reuse technology	$\frac{3}{15}$	2.82
4.	Effective landscaping and green roofs	$\frac{2}{15}$	1.88
5.	Alternative sources	$\frac{1}{15}$	0.94

Table 8. *Cont.*

S/N	Assessment Sub-Criteria	Fractions	Weighting Scores in %
	Waste Management, Pollution and Emission		$W = (12.82)$
1.	Operational waste management	$\frac{5}{15}$	4.27
2.	Construction waste management	$\frac{4}{15}$	3.42
3.	Waste recycling	$\frac{3}{15}$	2.56
4.	CO_2 and NO_X emissions reduction	$\frac{2}{15}$	1.72
5.	Construction and operational noise reduction	$\frac{1}{15}$	0.85
	Climate and Resilience to Environmental Hazards		$W = (11.54)$
1.	Climatology	$\frac{5}{15}$	3.84
2.	Flood control features	$\frac{4}{15}$	3.08
3.	Storm water channelling	$\frac{3}{15}$	2.31
4.	Climate responsive design	$\frac{2}{15}$	1.54
5.	On-site power generation	$\frac{1}{15}$	0.77
	Material Selection and Efficiency		$W = (10.26)$
1.	Region available materials	$\frac{5}{15}$	3.42
2.	Responsible sourcing and alternative materials	$\frac{4}{15}$	2.74
3.	Material reuse and recycling	$\frac{3}{15}$	2.05
4.	Use of green-labelled materials	$\frac{2}{15}$	1.37
5.	Durable materials	$\frac{1}{15}$	0.68
	Indoor Environmental Quality, Health & Wellbeing		$W = (8.97)$
1.	Efficient lighting and visual comfort	$\frac{5}{15}$	2.99
2.	Thermal and ventilation control	$\frac{4}{15}$	2.39
3.	Indoor air quality	$\frac{3}{15}$	1.79
4.	Occupant’s control	$\frac{2}{15}$	1.20
5.	Acoustic performance	$\frac{1}{15}$	0.60
	Safety and Security		$W = (7.69)$
1.	Health and safety measures	$\frac{5}{15}$	2.56
2.	Access control features	$\frac{4}{15}$	2.05
3.	Fire prevention methods	$\frac{3}{15}$	1.54
4.	Security systems	$\frac{2}{15}$	1.03
5.	Secure spaces	$\frac{1}{15}$	0.51

Table 8. *Cont.*

S/N	Assessment Sub-Criteria	Fractions	Weighting Scores in %
	Life Cycle Assessment and Integrative Process		$W = (6.42)$
1.	Environmental impact assessment	$\frac{5}{15}$	2.14
2.	Building whole life plan	$\frac{4}{15}$	1.71
3.	Embodied carbon impact of building materials	$\frac{3}{15}$	1.28
4.	Integrated strategy	$\frac{2}{15}$	0.86
5.	Building user feedback	$\frac{1}{15}$	0.43
	Sustainable Site, Location and Transportation		$W = (5.13)$
1.	Site selection or re-use	$\frac{5}{15}$	1.71
2.	Heat islands reduction through effective landscaping	$\frac{4}{15}$	1.37
3.	Access to public transport and car parking capacity	$\frac{3}{15}$	1.03
4.	Protection of ecological features and natural habitat	$\frac{2}{15}$	0.68
5.	Proximity to amenities	$\frac{1}{15}$	0.34
	Socio-Cultural Aspect		$W = (3.85)$
1.	Climate adapted local materials and features	$\frac{5}{15}$	1.28
2.	Vernacular architecture	$\frac{4}{15}$	1.03
3.	Design for inclusiveness	$\frac{3}{15}$	0.77
4.	Contribution to community	$\frac{2}{15}$	0.51
5.	Protection of cultural heritage	$\frac{1}{15}$	0.26
	Innovation, Sustainable Architecture and Design		$W = (2.56)$
1.	Building serviceability	$\frac{5}{15}$	0.85
2.	Building functional adaptability	$\frac{4}{15}$	0.68
3.	Aesthetics	$\frac{3}{15}$	0.52
4.	Innovative materials	$\frac{2}{15}$	0.34
5.	Innovative energy strategies (Smart Grid System)	$\frac{1}{15}$	0.17
	Life Cycle Cost Efficiency		$W = (1.28)$
1.	Life cycle cost analysis	$\frac{5}{15}$	0.42
2.	Building operation cost reduction	$\frac{4}{15}$	0.34
3.	Initial cost reduction	$\frac{3}{15}$	0.26
4.	Maintenance and building services cost reduction	$\frac{2}{15}$	0.17
5.	End-of-life cost	$\frac{1}{15}$	0.09

Source: Author's analysis, 2025.

Once the fractional values were obtained, they were then converted into percentages by multiplying each fractional score by the calculated weighting score of its parent criterion (*W*). This ensured that the weighting distribution of sub-criteria was consistent with the relative importance of their respective parent criteria.

The fractional formula for calculating the scores is shown below.

$$Ws = \frac{C}{TC} \times W\% \qquad (2)$$

Where: *Ws* is the calculated weighting for the sub-criteria;

C is the point allocated for each sub-criterion;

TC is the total number of points for all the sub-criteria;

W is the calculated weighting score for the parent criteria in %.

$$TC = C1 + C2 + C3 + C4 + C5$$

$$TC = 5 + 4 + 3 + 2 + 1 = 15 \text{ Points}$$

Figure 1 describes a framework for sustainability assessment, using the environmental, social and economic parameters. In order to monitor the environmental impacts of building construction and operation, many green building assessment methods have been proposed globally, such as LEED, BREEAM and Green Star [25]. These green building assessment tools are developed based on a country's social, environmental, and economic dimensions. Many underdeveloped and developing countries like Nigeria rely on green building assessment tools that were developed for Western countries, and these tools don't address their unique local setting, especially from the economic, governmental and cultural outlooks. This inspired the concern about the efficiency of using established assessment tools in measuring building performance outside their country of origin, due to global differences in climate, geography, economics and culture [25]. Nine (9) criteria: water efficiency, energy efficiency, indoor air quality, materials selection, effective management, land and waste, whole-life cost, quality of service and cultural aspects, and 36 sub-criteria were identified as the best assessment criteria for green building construction [25].

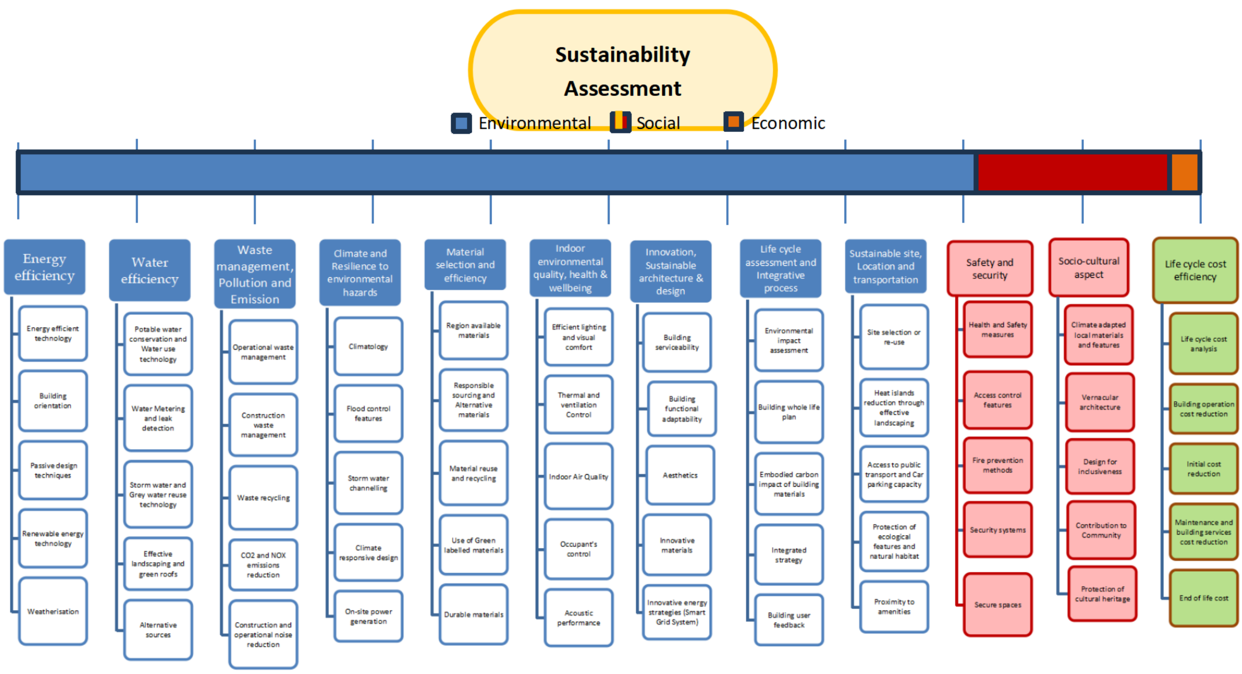

Figure 1. A flowchart representation of the Green Building experts' view.

5. Conclusions

The need to ensure the sustainability of building stock has compelled nations to develop Green Building Rating Systems (GBRS) as reliable yardsticks for assessing sustainable construction. In Lagos State, Nigeria, the current level of building project development and the involvement of professionals in construction practice necessitate an appraisal of the rating methods in place, with a view to enhancing their applicability.

Findings from the study reveal that the EDGE and LEED certification systems primarily focus their assessment and certification criteria on the environmental aspect of sustainability in buildings. Both systems operate at different levels of certification, which are dependent on the extent to which assessment criteria are fulfilled.

In examining their strengths and limitations within the local context, the study highlighted six thematic areas: building type, building phase, building scope, environmental aspect, social aspect, and economic aspect. A major strength of the two systems is their ability to assess and certify a wide range of building types—including residential, commercial/office, and industrial buildings—in the study area. Furthermore, while LEED can be applied to both new and existing (retrofitted) buildings, EDGE is limited in this regard as its software cannot calculate accurate data for existing buildings, particularly in aspects such as embodied energy.

The study identified a major limitation in both systems: their lack of functionality in addressing the social aspects of sustainability, such as safety, cultural integration, inclusivity, and community impact. To address this gap, a weighting framework of criteria for improving the adopted GBRS was developed, accompanied by a flowchart representing the views of green building experts in the study area.

In conclusion, while the EDGE and LEED systems are generally fit for assessing sustainable buildings in the study area—given their exclusive focus on the environmental dimension of sustainability—it is imperative that the following measures be considered to strengthen their applicability:

1. Adaptation of EDGE and LEED to incorporate social and economic aspects of sustainability, thereby improving their comprehensiveness in assessing and certifying green buildings.
2. Enhancement of the EDGE system to enable its application to existing and retrofitted buildings, overcoming its current limitations in data accuracy.
3. Government-led development of a home-grown GBRS tailored to Nigeria's context, which would deepen the applicability, relevance, and adoption of green building practices within the country.

Author Contributions

Conceptualization, A.B.W. and F.O.O.; methodology, N.V.N.; software, F.O.O.; validation, S.O.O., A.B.W. and P.O.I.; formal analysis, F.O.O.; investigation, F.O.O. and N.V.N.; resources, B.F.O.; data curation, P.O.I.; writing—original draft preparation, N.V.N., F.O.O. and A.B.W.; writing—review and editing, N.V.N. and S.O.O.; visualization, B.F.O.; supervision, A.B.W.; project administration, B.F.O. and P.O.I. All authors have read and agreed to the published version of the manuscript.

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Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki, and approved by the Departmental Research Ethical Review Board of the Department of Building, Obafemi Awolowo University, Ile-Ife, on the 9th of January, 2025. The Departmental Research Ethical Review Board handles low-risk, undergraduate and postgraduate student research. As no live animals, clinical trials, or medical records were involved in this research, it is considered a low-risk research and therefore no ethical approval code was assigned.

Informed Consent Statement

Informed consent was obtained from all subjects involved in the study.

Data Availability Statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Conflicts of Interest

The authors declare no conflict of interest.

AI Use Statement

The authors declare that no artificial intelligence (AI) tools were used in the preparation of this manuscript.

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