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GREEN BUILDING RATING SYSTEM (GBRS) AS A TOOL TO IMPROVE SUSTAINABILITY PERFORMANCE OF BUILDINGS IN THE BUILT ENVIRONMENT OF NIGERIA

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Abstract

In the worldwide, the impacts associated with the use of technological innovations and developmental processes in the built environment through the construction of buildings are phenomenal. This is noticeable in the literature on the role of green building practices in building construction, building operation and optimization, and building management; respectively. This has led stakeholders and policy drivers to adopt principles of sustainability by producing green building rating systems to assess building stock at different stages of their life cycle. Dealing with the issue, this paper aimed to review various attempts made by selected nations and other stakeholders to produce green building rating tools and focused on the need to develop a green building rating system for Nigeria to enhance the sustainability performance of the country's building stock. Given the various efforts by countries around the world to develop green building assessment tools, the paper found and maintained that Nigeria as a geographical entity cannot decide to be left out of the global trend to achieve sustainability through the need to have its own Green Building Rating System. The paper, therefore, recommended that there is a need to consider various assessments of the existing green building in either tropical or temperate region around the world and have a domestic green building rating assessment for the country to ensure that sustainability of her building stock can be promoted.

Keywords: Buildings; Environment; Green; Ratings; Sustainability.

1. Introduction

Over the years, there has been a growth in population in many parts of the world and this has put pressure on the availability and consumption of natural resources (Maja & Ayamo, 2021; Subramanian, 2018). The increase in the population also has an impact on environmental degradation and has become a popular catchphrase in the contemporary discourse (Mensah, 2019; Webber & Sciubba, 2019). In the construction industry, a large amount of wood resources is used for building works, and this accounts for one-quarter of its wood harvest

and about two-fifths of its material and energy flow (Maier, 2021; Ramage et al., 2017). This undoubtedly leads to the reduction of natural resources and the acceleration of global warming which are potential environmental hazards seen in the 21st century, and this requires issues on policy formulation (Scovronick et al., 2017; Zuo & Zhoa, 2014). According to Poveda and Young (2014); Cole (2019), there has been increasing demand for the exploration of natural resources, which has created associated impact and forced the stakeholders concerned on the need to evolve ways to mitigate the associated effects. This can be seen in the form of green building (Dania et al., 2013; Kattumuri, 2018; Cole, 2019) that adopts the concept of sustainable construction through which buildings are constructed; by using clean and resource-efficient measures, gotten from the extraction of raw materials to component disposal in the construction industry (Ojo et al., 2014).

The sustainability concept was initially introduced by the World Commission on Environment and Development in its publication "Our Common Future". According to the Brundtland (1987), sustainable development is defined as the idea that human societies must live and meet their needs without compromising the ability of future generations to meet their own needs. The basis of sustainability involves the use of renewable resources at a rate that does not exceed its rate of renewal and the use of non-renewable at a rate that does not exceed their substitution capacity (Cruz et al., 2019; Ding, 2008). To overcome the consequences of resource depletion, the solution offered by the real estate and building industry has been the establishment of green building (Maurice, 2016; Oyewole et al., 2019; Varma & Palaniappan, 2019). This issue has led to the development of building environmental assessment system as an important part of the planning, design, construction, and operation of buildings. Countries around the world have conducted various attempts to develop green building certification systems to conserve energy and evenly reduce the production of greenhouse gas emissions (Vlad-Andrei et al., 2020; Yun et al., 2018). The success story gotten from their introduction has made green certification systems increase rapidly, and it has made various research and technologies develop along this path (Kim et al., 2020).

According to Sua et al. (2020), in most developed nations, the green building concept has become popular to reduce the impact associated with the development and use of building

stock. In the recent years, many agreements and conventions have been held such as the Rio Earth Summit of 1992, the Johannesburg Earth Summit of 2002, the Washington Earth Summit of 2003, UN-HABITAT Conference on promoting and fostering Green Building Rating System (GBRS) in Africa 2010, the Brussels Green Week Conference of 2014 amongst others (Usman & Khamidi, 2012). Various countries developed different green building rating tools to evaluate sustainable performance of their building stock (Ragheb et al., 2016). The use of green building rating systems which has so far been adopted in several countries of the world has helped in the use of energy-efficient measures in the construction industry. Quite several underdeveloped and developing nations have so far shown the necessary interest in the adoption and development of green building practices, and Nigeria, a country in Sub-Sahara Africa, is not an exemption (Olaleye et al., 2015). This serves as a major thrust for this paper to review the existing hub of rating tools globally to have such initiative in the country to promote sustainability of the nation's buildings.

According to Mao et al. (2009), the benefits of most of these rating systems are to assess the performance of the adoption of sustainable construction, guide the entire process of sustainable construction to meet the three legs of sustainability (economic growth, environmental balance, and social progress). It also provides better conditions for building occupants through enhanced indoor air quality, production of energy-efficient products and ecosystem protection (Illankoon et. al., 2019; Ojo-Fafore, et al., 2019). The green building certification system was developed to enhance the efficiency and sustainability of buildings, and ultimately, to promote global environment preservation and equally give due considerations to the health and comfort of the building occupants (Kim et. al., 2020). The green building certification system assesses different indicators comprising energy, raw materials, pollutants, design, construction, maintenance, and dismantling throughout the entire life cycle of buildings.

As a part of the green building development initiatives, different types of green building rating systems (GBRS) have been developed by the available local and international research bodies such as the Building Research Establishment's Environmental Assessment Method [BREEAM] developed in the UK, Leadership in Energy and Environmental Design [LEED] of the US, SB TOOL (Sustainable Building Tool), CASBEE (Comprehensive Assessment

System for Building Environment Efficiency; Japan), Eco Profile, HK-BEAM (Hong Kong Building Environment Assessment Method), NABERS (National Australian Building Environment Rating System), Green Globes, BCA-GM (Building and Construction Authority-Green Mark, Singapore) and GOBAS (Green Olympic Building Assessment System, China) (Kim et. al., 2020; Liu & Leng, 2020).

The use of green building rating systems has been adopted in several countries of the world and this has helped in the use of clean and energy-efficient measures in the construction industry. In Nigeria, the use of this system has not been embraced by the public and this has led to the continuous use of natural resources and emission of harmful gases into the atmosphere by the construction industry players which have been documented to be potential threats to the sustainability drive. Few studies on GBRS have been conducted by researchers in Nigeria. These studies include those carried out by Amasuomo et al. (2017) on the development of building performance assessment and design tool for residential buildings in Nigeria.

The study reviewed the LEED and BREEAM rating systems; while Arum (2011) reviewed environmental impacts of building construction, efforts to be made to keep the environment green and concluded that green building solution should be achieved through synergistic processes. While Dodo et al. (2011) worked on the need for the establishment of Green Building Council for Nigeria but did not make mention of the development of GBRS for Nigeria. Given the foregoing, these studies did not include green building characteristics used in the rating systems as a basis for the institutionalization of the green building rating system for the country. Thus, the aim of this paper was to carry out a review of the green building rating systems available globally and provide channels towards institutionalizing it in the country to promote the sustainability of the existing and proposed building stock in the built environment.

2. Methods

This paper is a review type and reviewed the various steps and initiatives taken by different nations and stakeholders across the globe on the need to produce green building rating tools to enhance the sustainable performance of building stock. It also considers the steps taken so

far or done by arms of government to promote the green building process in the country, Nigeria. It looks at the associated variables based on the characteristics, strengths and weaknesses of the existing rating tools used in other countries. The research data were culled from the body of existing steps and actions taken across the globe in a way to promote green building development through its assessment and rating processes. The information obtained from the available steps taken so far by the government and relevant stakeholders were extracted to develop green building stock and its assessment processes for the country.

3. Results and Discussions

Many stakeholders are currently concerned with the task of how to sustain resources, way of life, and the environment while making efforts to develop the world. This is clearly due to the continued population growth and accelerated urbanization globally, which has put pressure on environmental resources (Kattumuri, 2018). According to Slabbert (2013) and Nugroho et al., (2019), the need for sustainability is the use of renewable resources at a rate that does not exceed the renewal rate and the consumption of non-renewable materials; at a rate that does not exceed their substitution capacity. The built environment has a substantial impact on human health, economy, and natural environment while its economic and environmental performance can be maximized by adopting green building (GB) practices which are the fundamental goals developed to reduce waste and conserve energy (Mensah, 2019). These GB practices are incorporated directly from the design stage and construction stage, respectively; to renovation and deconstruction (demolition). The green buildings are thought of how to achieve core purposes such as consumption of water, energy, protecting occupant's life, and improving employee's productivity respectively. Similarly, increasing concerns of stakeholders on the detrimental impacts of the construction industry on the natural environment and human health have increased the awareness of green building (GB) globally (Darko et al., 2018; Horman, et al., 2006).

To deepen the improvement in the building sustainability, the green building rating systems are used as guidelines to fulfill the dream of sustainability and technological innovation (Zafar, 2019). The assessment tools to be used must also meet the needs of growing the industry players to be able to benchmark performance and adaption of the

existing tools and the likely development of any proposed ones to satisfy core indicators of sustainability. Arguments on the benefits of the tools can be heard from stakeholders, the rating systems have served as a piece to enhance improved sustainable practices in the building industry. Some benefits can be described as tangible and measurable, such as reduction of energy and water consumption, greenhouse gas emissions; while the others are subject to explanation, but subjective (Poveda & Young, 2015). This requires the use of different key performance indicators (KPIs) to report the associated social, environmental, and economic performance of buildings. Despite various assessment models, processes, and methods, practitioners should develop tools that can let buildings meet the required standards of green or sustainable performance (Cole, 2019; Mateus & Braganca, 2011). In the same vein, Goi (2017), Poveda and Lipsett (2014), and Sua et al. (2020) noted that rating systems used in the building industry need a certain degree of innovation and there is the dire need to explore its adaptation in the industrial areas and other sectors in various countries.

3.1. Green Building Practices Related to Building Construction

According to Poveda and Young (2015), the green revolution that found its way into the building industry has tangible benefits that have undertaken stakeholders benefit from green and sustainable construction strategies. Such a revolution has made it possible to impart on how buildings are constructed, the technological approaches to be used, which would assist in the development and implementation of environmental rating systems (Ahn et al., 2016). Responding to the issue, the itineraries associated with building projects, right from site planning, materials of construction, and incorporation of facilities like water and energy services to be used are important. Zigenfus (2008) considered the green design initiatives that can impact the environment by reducing pollution while Boyle (2005) considered the adoption of green roofs covered with plant growth.

3.2. Green Building Practices Related to Building Operation and Optimization

Green certification represents a great reputation and emerging mega-trends for buildings in terms of its associated benefits to its operation and optimization in the real estate sector (Kim et al., 2020). The green certification system in the well-being of present and future generations and is one of the strongest elements in the real estate market due to the use of

services such as energy and water in buildings (Eichholtz et al., 2013). Visual comfort, according to Maachi et al. (2019) is achieved when there is good lighting that is adequate in both quality and quantity. Thus, proper orientation and adequate spacing must be maintained to improve natural lighting and adequate window openings must be done to ensure that the internal environment of the building gets enough natural light. Katabaro and Yan (2019) also noted that a visually active and high-quality working environment is essential for the optimal performance of the occupants.

3.3. Green Building Practices Related to Building Management

Green building certification systems indicate a symbolic advance in the performance appraisal as it offers many return benefits than conventional buildings can offer. Usually, this is about the skill sets in the pre-planned business procedure to attain sustainability along the line. It is also captured in the scope of planning, coordination to save cost while also protecting natural resources and the environment at large (Sinha et al., 2015). Resources management is the appreciable use of natural and artificial resources so that buildings can be sustainable for the use of the present and future occupants. Sustainable procurement helps to decrease detrimental environmental, social, and economic impacts made on goods and services during the life cycle of buildings (Brammer & Walker, 2011).

3.4. Green Building Rating Systems (GBRS)

Life cycle assessment of buildings in terms of their performance based on specified performance indicators (Nwodo & Anumba, 2019). It shows the essential to assess them and determine their sustainability drive. According to Sharma et al. (2011), life-cycle assessment (LCA) needs methods and tools to determine the environmental impacts of buildings and there a need to design buildings to aid sustainability drive. UN-Habitat (2010) argues that rating systems are voluntary mechanisms that are used to rate and verify a building's energy and environmental performance.

The Green Building Rating System (GBRS) helps in assessing building performance holistically with the sole purpose of achieving sustainability (Tang et al., 2020). It provides procedures to design, construct and maintain buildings in energy and environmentally

friendly way by taking into consideration, energy and water consumption and the indoor environmental quality of buildings as the core indicators (Ding, 2008; Happio & Viitaniemi, 2008; Papadopoulos & Giama, 2009). According to Sua et al. (2020), the increased quest for green building and rating tools decreases the impact of building use on climate, natural environment quality and equally decreases the use of materials that are toxic, unethical and unsustainable.

The rating systems allow the performance of similar building types to be compared and set criteria against which a building can be rated to show the building's scorecard to promote a sustainable environment image (Bougdah & Sharples, 2009). There are different types of GBRS used in different countries across the globe as the first GBRS developed in 1990 was BREEAM, LEED in 2002, CASBEE, and several others have also produced theirs. Some countries developed their GBRS from other's own, most especially from BREEAM (UK) and LEED (US) (UN-Habitat, 2010).

Table 1 shows some of the GBRS used globally and their respective development source(s). The Table shows the associated measurement systems/parameters used by the respective green building rating system and the country where each of them originated. With the outlook, the rating systems would provide a platform through which the rating of buildings can be determined through set criteria used as the benchmark. The measurement systems developed in each of the stated countries are equally important to conduct life cycle assessment of buildings in terms of the assigned parameters. This Table's measurement systems of the stated countries underpin why they serve as a reference that is being adopted by other countries and stakeholders in the globe to promote sustainability drive of buildings.

Table 1. List of countries and their sustainable building rating systems

Country	Measurement system	Country	Measurement system
Australia	NABERS / Green Star	China	GBAS
Brazil	Brazil AQUA / LEED	Finland	PromisE
Hong Kong	HKBEAM	Japan	CASBEE
Netherlands	BREEAM	Germany	DGNB / CEPHEUS

Country	Measurement system	Country	Measurement system
Jordan	Netherlands EDAMA	Portugal	Lider A
New Zealand	Green Star NZ	France	HQE
Singapore	Green Mark	Spain	VERDE
Republic of China (Taiwan)	Green Building Label	South Africa	Green Star SA
Korea	KGBC	United Arab Emirate	Estidama
Switzerland	Minergie	Mexico	LEED Mexico
United Kingdom	BREEAM	Czech Republic	SBToolCZ
Malaysia	GBI Malaysia	India	Indian Green Building Council (IGBC) / GRIHA
Pakistan	Institute of Architecture Pakistan Green Sustainable Arch	Italy	ProtocolloItaca/Green Building Council Italia

(Source: Atanda & Olukoya, 2019)

3.5. Characteristics of Different Green Building Rating Systems (GBRS)

Each of the rating systems has its characteristics that are used in the assessment of buildings (Bernardi et al., 2017). They provide a framework used for implementing measurable green building design (Gobbi et al., 2016; Shan & Hwang, 2018). The different characteristics based on the operation of the green building rating systems are shown in Table 2. The characteristics comprise amongst others management, health and well-being, energy, transportation, materials, land use, ecology and pollution used under the consideration of the BREEAM rating system. Other rating systems such as CASBEE, GBTOOL, LEED, Green Globes and Green Star have their respective characteristics as depicted in the Table, which is respectively used in the assessment of the performance of buildings. The measurable

parameters and characteristics serve as the basis in the assessment of the environmental and sustainable performance of buildings.

Table 2. List of some of the rating systems and their characteristics

Rating Systems	Characteristics
BREEAM	Management
	Health and well being
	Energy
	Water
	Transportation
	Materials
	Land use
	Ecology
	Pollution
CASBEE	Indoor Environment
	Quality of services
	Outdoor Environment on site
	Energy
	Resources and materials
	Reuse and reusability
	Off-site environment
GBTOOL	Energy consumption
	Resource consumption
	Environmental loadings
	Indoor environmental quality
LEED	Sustainable site
	Water efficiency
	Energy and atmosphere
	Materials and resources
	Indoor environmental quality
	Innovation and design
Green Globes	Project management

Rating Systems	Characteristics
Green Star	Site selection Energy Water Indoor environment Resource, building materials, solid waste Governance Design Economic prosperity Innovation Environment

(Source: BREEAM, 2006; CASBEE, 2004; USGBC, 2004)

3.6. Overview of the Green Building Rating Systems

An overview of the five green building rating systems used in different parts of the world subjected to review is summarized in this section to show their respective traits, features, and operations respectively. They comprise BREEAM, CASBEE GBTOOL, LEED, and GREEN GLOBES. The rating systems promote eco-friendly, sustainable building stock, improved comfort conditions of building stock (Mattinzioli et al., 2021). Thus, different countries use various green building rating systems to estimate greenhouse gas emissions, set standards for green building designs and their materials specifications to conform to the global best practices.

According to Sua et al. (2020) the first green building rating tool in existence globally was the Building Research Establishment's Environmental Assessment Method (BREEAM), which was established by the United Kingdom Building Research Establishment (BRE) in 1990. The USA Green Building Council, in 1996 founded the rating evaluation tool called the Leadership in Energy and Environmental Design (LEED). Thereafter, other notable rating tools of Australia, GREENSTAR, Singapore's, GREENMARK, Japan's, CASBEE, and Malaysia's Green Building Index were established (Babarinde et al., 2019).

3.7. BREEAM (Building Research Establishment's Environmental Assessment Method)

Building Research Establishment's Environmental Assessment Method (BREEAM) was created for building stock in the UK and is moderated by the BRE Global Sustainability Board that carries out the certification process of different types of buildings, namely school buildings, industrial buildings, residential buildings, and other institutional buildings (BREEAM, 2008). This Board represents participants in the construction sector of the UK's construction and is subject to the statutes of the BREE Global Governing Body, which oversees BREE Global operations (Aubree, 2009). It has four assessment tools used at different stages of the life cycle of buildings. These tools include Design and Procurement (D&P), Post Construction Review (PCR), and Fit Out Assessment respectively. The operation process of BREEAM involves the award of credits in 10 groups of building stock for meeting different performance indicators aimed at reducing the possible negative impact of buildings and equally enhance environmental benefits that can be achieved from its use. The quantitative methods are an important aspect in assessing the sustainability performance of buildings (Doran, 2019).

The various indicators used for the Design and Procurement in the BREEAM rating system comprises management: (commissioning, monitoring, waste recycling, pollution minimization and material minimization), health & wellbeing: (adequate ventilation, humidification, lighting and thermal comfort), energy: (sub-metering, efficiency and CO_2 impact of systems), transport: (emissions, alternate transport facilities), water: (consumption reduction, metering, leak detection), materials: (asbestos mitigation, recycling facilities, re-use of structures, facade or materials, use of crushed aggregate and sustainable timber), land use: (previously used land, use of remediated contaminated land), ecology: (land with low ecological value or minimal change in value, maintaining major ecological systems on the land, minimization of biodiversity impacts), pollution: (leak detection systems, on-site treatment, local or renewable energy sources, light pollution design, avoid use of ozone-depleting and global warming substances). The BREEAM has comparative advantage by enabling comparison and benchmarking of different buildings (Table 3).

Its assessment can be carried out independently and it also be used to assess any building within the BREEAM bespoke version that is captured within the British law and culture.

However, it has drawbacks in spending on the need to comply with its operational guidelines, and its weighting rating system is also cumbersome (Atanda & Olukoya, 2019). Thus, Table 3 shows the appropriation of weighting process done for the respective indicator used in the assessment of green building compliance of buildings, which comprise management, health and well-being, energy, transport, water, materials and wastes, wastes, land used and ecology, and pollution, respectively.

Table 3. Sections and weighting of BREEAM

Section	Weighting
Building Management	12
Health and well-being	5
Energy	19
Transport	8
Water	6
Materials and wastes	12.5
Wastes	7.5
Land use and ecology	10
Pollution	10

(Source: BREEAM, 2008)

3.8. CASBEE (Comprehensive Assessment System for Building Environment Efficiency)

The Comprehensive Assessment System for Building Environment Efficiency (CASBEE) is the building rating system developed in 2001 in Japan by the Japan Sustainable Consortium to create the Green Building Rating System (GBRS). It is considered the deepest eco-efficiency expression and the most comprehensive relationship between building and its environment (Shamseldin, 2018). The system considers the life cycle of buildings and considers stages such as pre-design, new construction, existing buildings, and renovations, respectively (CASBEE, 2006; JSBC, 2005).

CASBEE differentiates environmental loadings noted as the negative impact on the environment outside the enclosed space, while the quality of building performance, equally

noted as the improvement of environmental quality within the enclosed space. These two indicators can be depicted as a dimension of eco-friendly or BEE (Building Environmental Efficiency) plotted on a graph with one coordinate for the environmental load on and the building quality on the other (CASBEE, 2006). The major indicators considered by CASBEE comprise building environmental quality and performance, indoor environment, quality of services, outdoor environment onsite, building environmental loadings, energy use, resources and materials and offsite environment (Andrade & Braganca, 2016).

3.9. GBTOOL

The GBTOOL is the software produced by the Green Building Challenge (GBC) assessment method that has been under development since 1996 by the International Initiative for Sustainable Environment (iiSE) with more than 20 participating countries (Chang et al., 2007). It uses a scale that ranges from +1 to +5, which is meant to assess indicators such as site selection, project planning and development, energy and water consumption, indoor environmental quality, social and economic aspect, long-term performance, and functionality by making use of local benchmarks to provide a comprehensive assessment of buildings (Cordero et al., 2019; Fowler & Rauch, 2006).

The GBTOOL also considers different criteria comprising rate of energy consumption assessed through the total use of non-renewable energy while resource consumption is assessed on how materials can be salvaged, recycled, bio-based cum harvested sustainably, locally produced, designed for dis-assembly, re-use and the possibility of use of wastewater for irrigation purposes. It also accommodates building systems and occupants focussing on indoor environmental quality which are assessed through indoor air quality, ventilation, temperature, relative humidity, daylight, illumination, acoustics; environmental loadings that impact greenhouse gas emissions, solid wastes, stormwater and wastewater generations (GBI, 2006).

3.10. LEED (Leadership in Energy and Environmental Design)

The Leadership in Energy and Environmental Design (LEED) came up through the initiative of the United States Green Building Council in 1993 and it was led by Robert Watson of the

United States Green Building Council (USGBC). It is based on the existence of BREEAM and addresses specific environmental-related impacts in buildings (Nguyen & Altan, 2011). It has four certification levels which are used to rate different categories of buildings which are classified as Certified (40%), Silver (50%), Gold (60%), and Platinum (80%) respectively (Yudelson, 2010).

According to (USGBC, 2009), LEED comprises five environmental categories namely water efficiency, sustainable site, energy and atmosphere, materials, and indoor air quality. It also provides deeper insight into meeting credits within environmental issues on areas concerning the sustainable site, water efficiency, energy and atmosphere, and materials and resources respectively.

3.11. Green Globes

The Green Globes served as an extension of the BREEAM, and it was initiated in the year 2004 for the assessment of existing buildings through the Green Building Initiative (GBI). Green Globes adopted the "Go Green Comprehensive", as the matching words for the action plan on the assessment phases to be carried out (Bryan & Skopek, 2008). The rating system has specified criteria used in its assessment, which include project management, site, energy, water, indoor environment, resources, building materials, and solid waste respectively (GBI, 2006). Through its assessment process, buildings can be assigned different rating levels such as LEED Bronze, Silver, Gold, and Platinum (GBI, 2006). Table 4 shows the existing five rating systems highlighted, and their respective certification process. The Table depicts the flow of categories used in the assessment of the sustainable performance of buildings and the associated remarks to be given to each of them based on the weighting process done. It shows the potentials of each of them in terms of their respective strengths and weaknesses.

Table 4. Available Rating Systems and Potentials

Rating System	Criteria Category	Certification Credits	Year of Development	Strengths and Weaknesses
BREEAM	Management Health and wellbeing	Pass Good	1990 in the United	STRENGTHS allows comparison and

Rating System	Criteria Category	Certification Credits	Year of Development	Strengths and Weaknesses
	Energy Water Transportation Materials Land use Ecology Pollution	Very good Excellent Outstanding	Kingdom	benchmarking of different buildings, any building that can be assessed by BREEAM can be independently assessed WEAKNESSES requires very exact requirements, the weighting system is complex, high cost of compliance
CASBEE	Indoor Environment Quality of services Outdoor environment on site Energy Resources and materials Reuse and reusability Off-site environment	Level 1 Level 3 Level 5	2001 in Japan	STRENGTHS Highly comprehensive and versatile WEAKNESSES Has no external benchmark
GBTOOL	Energy consumption Resource consumption Environmental loadings Indoor environmental quality Other criteria	+1 to +5	1998 by different countries	STRENGTH

Rating System	Criteria Category	Certification Credits	Year of Development	Strengths and Weaknesses
LEED	Sustainable site Water efficiency Energy and atmosphere Materials and resources Indoor environmental quality Innovation and design	Certified Silver Gold Platinum	1998 in the United States	STRENGTH Strong marketing which gets the message through, lots of available information, no need for training and assessor WEAKNESS Certification can be costly, doesn't address life-cycle assessment
GREEN GLOBES	Project management Site Energy Water Indoor environment Resource, building materials, solid waste	LEED Bronze Silver Gold Platinum	Brought to Canada in 1998	STRENGTH Reduce cost, employs simple methodology, designs can be influenced WEAKNESS Life cycle assessment is not sufficiently addressed, its weighting system is not transparent

(Source: BREEAM, 2006; CASBEE, 2004; GBI, 2006; USGBC, 2004)

3.12. Green Building Council and Certification Process in the Context of the World and Nigeria

The World Green Building Council (WGBC) which was established in 2002 has been described as the body of many green building councils in not less than one hundred countries as of December 2016 and has a major role to ensure the establishment of green building councils on how to synergize on the exchange of knowledge in green building practice. It also strengthens emerging green building councils in countries on how to transform the building industry and promote the sustainability of the building stock (WGBC, 2011). The WGBC

provides a framework that supports member council bodies whereby they are legally registered while the emerging members shall be expected to move to the established status within 24 months. The existence of green building council is felt in nations across the globe; however, it is only South Africa that has an effective Green Building Council in sub-Saharan Africa.

The operation mechanism of the Green Building Council to promote sustainability in the building industry is the evolution of the rating system, which has served as a modest response to the issues of building performance, environmental impact, cost efficiency, energy management, and maintenance (Anzagira et al., 2019; Osman, 2010). Thus, the Green Building Rating Systems have been developed to assist stakeholders to analyse green building performance using different key performance indicators in the assessment process. The rating systems are basic tools used to assess, rate, and certify the environmental performance of the building stock by using different performance targets (Poveda, & Lipsett, 2014; UN-Habitat, 2010).

Considering that the need to incorporate green futures into structures that will engage stakeholders in the building industry, the urge to give the strengthening of green building council in nations has gotten a boost because it will considerably reduce the overall occupants' health, improve employee's productivity, reduce waste, pollution and environmental degradation (Francis & Ian, 2014). Emerging from the increased formation of green building councils in countries across the globe, Nigeria, in sub-Sahara Africa took several steps towards creating a green building process (Akinyemi et al., 2017; Ying et al., 2021). Also, according to Abisuga and Okuntade (2020), the negative impact of construction activities on the economy and the environment has necessitated the need for a green policy formulation and framework in developing countries like Nigeria. To ensure the development of the green policy, it is necessary to evaluate the green building policy, the operations of the Green Building Council of Nigeria (GBCN) so that the design, construction, management, and use of buildings may be captured in the National Building Code (NBC) shall have ways through which buildings can be assessed to allow their certification and eco-labeling purpose.

Due to the urgent need to domesticate the Green Building Council and green building rating system (GBRS) in Nigeria sequel to the mission of the WGBC to strengthen the

existence of the council in member countries, by advancing their leadership, the government of Nigeria like few other African nations, have undertaken efforts in this regard. Although there is yet to be an established green building rating standard in Nigeria, the Federal Government of Nigeria through the Federal Ministry of Environment (FME) regulates and imposes environmental laws to protect the country's environment. Some of these existing laws include the Federal Environmental Protection Agency Act of 1988, National Policy on the Environment (NPE) of 1989 and Environmental Impact Assessment Act (EIA Act) of 1992 (Atanda & Olukoya, 2019).

4. Conclusion

The critique and the review carried out on the green building rating system has shown that developmental processes through the construction of buildings, their associated life cycles, and the use of relevant technology products would negatively impact the environment around the world. Previous studies along these lines and the positions made by the World Green Building Council (WGBC) demonstrate this. This is clearly seen in the effects that the construction and use of buildings on the environmental, social, and economic indicators that determine the sustainability process. Given the awareness of government and stakeholders around the world about unforeseen effects buildings could have on the environment, various green building rating systems were developed, and more are still joining the catalogue of those in existence.

To align with the global trend on the review of the green building rating systems across the globe, and the mandate on member countries in both developed and developing nations on the need to strengthen the establishment of green building council and the process of institutionalizing green building rating systems, this paper recommends as follows; that improved awareness should be given to green building practices through its integration in the curricula of higher institutions of learning, the need to strengthen Nigeria Green Building Council that ought to give cursory consideration to the peculiarities of our local environment by establishing Green Building Rating System that engages practitioners, professionals, and stakeholders in the planning, design, construction, and use of buildings to promote sustainability drive. The government should also give the initiative the required legislative

and executive support it deserves to let the country join the league of nations that are increasingly promoting sustainability drive.

Through these recommendations, the paper concluded that the drive to ensure the sustainable performance of building stock in the country would be achieved. This study is therefore limited to the review of literature on the processes that led to the establishment of green building rating systems in nations around the world, which would pave way for such to be deemed worthy to be established in Nigeria. Future research in this area should focus on the frame of adoption of the green building rating system in the country, its level of compliance and its relevance in mitigating the impacts of the use of building stock on the environment.

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Authors' Contributions

All the authors designed the study, chronicled background to the study, were involved in the review of the literature, development of the methodology, build-up of the results and approved the final manuscript.

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