

Article

Utilization of Sustainable Building Rating Tools in the Nigerian Construction Industry

Peter Oluwole Akadiri

Architectural Engineering Program, College of Engineering, University of Buraimi, Al Buraimi 512, Oman;
peter.a@uob.edu.om

Abstract: Sustainable building rating tools (SBRTs) are essential for assessing the environmental impact of buildings, continuously evolving to meet the needs of users. In Nigeria, the effectiveness of these tools depends on their ability to meet the country's sustainable building standards and environmental goals. While adopting sustainable building rating tools is crucial for realizing the benefits of sustainable construction, little is known about their actual utilization in the Nigerian construction industry. This research aims to (1) assess the level of awareness and utilization of sustainable building rating tools among diverse stakeholders—including architects, engineers, sustainability consultants, developers, contractors, and suppliers—within Nigeria's Architecture, Engineering, and Construction (AEC) sector, and (2) explore drivers and barriers to their use. The study adopts an explanatory sequential mixed-methods design, starting with a survey of 98 Nigerian building professionals, followed by qualitative analysis. Results show that while 72.4% were aware of SBRTs, only 39.8% had used them, highlighting a gap between awareness and application. Utilization was higher among professionals with greater experience, income, and education. Barriers included high certification costs, tool complexity, and socio-economic factors, while key drivers were government regulations and environmental benefits. The study calls for targeted education, tool simplification, and financial incentives to boost adoption and promote sustainable construction in Nigeria.

Keywords: sustainable building rating tools; utilization; barriers; drivers; Nigeria construction industry



Academic Editor: Antonio Formisano

Received: 16 April 2025

Revised: 23 May 2025

Accepted: 31 May 2025

Published: 7 June 2025

Citation: Akadiri, P.O. Utilization of Sustainable Building Rating Tools in the Nigerian Construction Industry. *Architecture* **2025**, *5*, 38.

<https://doi.org/10.3390/architecture5020038>

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1. Introduction

The global construction industry is increasingly recognizing the need to incorporate sustainability into its operations due to escalating environmental challenges, such as climate change, resource depletion, and urban sprawl [1,2]. As countries worldwide strive to mitigate the environmental impact of construction, the emphasis on sustainable building practices has gained momentum. This awareness is driven by a growing understanding of the construction sector's significant contribution to energy consumption, waste generation, and carbon emissions [3,4]. In particular, the global trend toward sustainability in construction is further influenced by international climate agreements, rising energy costs, and the need to improve the quality of life through eco-friendly buildings [2,5]. In Nigeria, however, the adoption of sustainable construction practices faces unique challenges according to [6]. The country is grappling with rapid urbanization, deforestation, and environmental degradation, which necessitate a more concerted effort to embrace sustainability [7,8]. While the global construction sector is taking bold steps toward greener practices, Nigeria's construction industry lags behind due to infrastructural, socio-economic, and regulatory

hurdles [9,10]. These disparities highlight the critical need for sustainable building solutions tailored to Nigeria's specific environmental, economic, and social contexts. As such, the integration of sustainable building rating tools (SBRTs) within Nigeria's construction practices is both timely and essential for addressing the nation's pressing environmental issues. The construction sector is a major perpetrator of these problems, having enormous inputs in energy use, waste, and carbon emissions [11]. For instance, the over-extraction of building materials, such as steel and cement used in construction, eventually hurts the environment since their manufacture utilizes a high quantity of energy [12]. Furthermore, inadequate waste management during construction works results in the accumulation of trash, which exacerbates environmental degradation [13].

Economically, Nigeria's reliance on fossil fuels and imported construction materials has put pressure on its foreign exchange reserves and resources [14]. The high cost of importing materials, combined with fluctuating exchange rates, makes construction projects expensive and hard to maintain over time [15,16]. This shows the need for cheaper, locally made materials that can reduce Nigeria's reliance on imports and help local businesses. Socially, Nigeria's fast-growing population and expanding cities have caused a shortage of housing, bad living conditions, and a lack of good infrastructure, especially in big cities [17]. The shortage of affordable and sustainable housing has led to the rise of informal settlements, often marked by overcrowding, poor sanitation, and vulnerability to environmental risks [18]. These challenges make it clear that sustainable building practices are needed to protect the environment, strengthen the economy, and ensure social fairness. Sustainable building rating tools (SBRTs) offer standardized frameworks designed to enhance resource efficiency, reduce waste, and improve living standards [19]. These tools assess various environmental impacts, including energy efficiency, water usage, materials sourcing, indoor air quality, and waste management [20]. By providing a structured approach to sustainability, SBRTs help identify opportunities for optimization and serve as valuable benchmarks for developers, architects, and policymakers [19]. They also guide informed decision making that aligns with environmental goals and contributes to sustainable development [20].

Sustainable building practices aim to reduce the environmental impact of buildings while also improving economic and social well-being [21]. A big part of these practices is using sustainable building rating tools, which help measure and certify how eco-friendly buildings are [22]. Over time, they have become important tools for addressing diverse environmental, social, and economic criteria, enabling stakeholders to make informed decisions that align with sustainability goals [1].

In Nigeria, a rapidly urbanizing nation with a growing construction sector, the use of sustainable building rating tools in the construction sector is still not fully explored [23]. This limited exploration is largely due to several factors, including the lack of awareness among key stakeholders, inadequate training and education, and the high upfront costs associated with certification [24–26]. A study by Ebekozen et al. [23] notes that although awareness of SBRTs is growing, the application of these tools remains low due to a lack of sufficient local knowledge and resources. Furthermore, regulatory frameworks that support the widespread adoption of SBRTs are still underdeveloped, and there is a need for more localized tools that align with Nigeria's specific environmental, social, and economic contexts [27]. The challenges of integrating SBRTs into Nigeria's construction industry are also compounded by financial constraints, as many developers prioritize short-term cost savings over long-term sustainability goals [28]. Additionally, there is resistance to change within the sector, with many professionals adhering to traditional building practices that do not prioritize sustainability [1].

While these tools are well known for their potential to promote sustainable building practices, their success in Nigeria depends on how well they align with local building codes, environmental priorities, and socio-economic realities [23,27]. Despite the global push for sustainability, there is limited research on how these tools are being applied in Nigeria, what factors influence their use, and what barriers and drivers impact their adoption.

2. Literature Review

2.1. Sustainable Building Rating Tools

The evolution of Sustainable Building Rating Tools (SBRTs) over the past three decades has been transformative. Initially, these systems focused narrowly on energy efficiency, material conservation, and environmental performance. BREEAM, launched in the UK in 1990, and LEED, introduced by the United States in 1998, were early examples that established benchmarks for energy-efficient and low-impact building practices. Over time, their scope expanded to include broader aspects of sustainability, including indoor environmental quality, water conservation, and life-cycle impacts. From the late 1990s through the 2000s, countries began to develop region-specific SBRTs, such as HQE (France), BEAM-HK (Hong Kong), Green Globes (Canada), and CASBEE (Japan), reflecting a growing recognition of local priorities, as seen in Figure 1. Between 2006 and 2025, the global proliferation of tools such as Green Star (Australia and South Africa), Estidama (Abu Dhabi), LEED India, and the Living Building Challenge (USA) marked a continued shift toward a more holistic understanding of sustainability that also encompassed social and economic dimensions.

Despite these advancements, the term “sustainability” remains contested, often criticized as vague or inconsistently applied [29,30]. Many SBRTs have been scrutinized for failing to fully capture the complexity of sustainable development, particularly in developing regions where contextual challenges, such as poverty, informal construction practices, and climate vulnerability, are more pronounced [19,31]. This assertion is reinforced by Anyanya et al. [20], which states that the tools were often designed for developed, temperate-climate contexts and urban settings, limiting their relevance in tropical regions with different environmental, economic, and cultural realities. For instance, SBRTs such as LEED and BREEAM have been criticized for their reliance on Western construction technologies, standardized material supply chains, and data-intensive assessment frameworks [32,33]. These assumptions can be problematic in contexts such as Nigeria, where climate conditions, construction traditions, and local resource availability differ significantly. Akadiri [1] noted that Nigerian architects and developers face substantial challenges in applying international SBRTs, including the lack of locally relevant environmental data and disconnects between imported standards and indigenous building practices. Similarly, Lazar and Chithra [34] emphasized that high humidity, heat stress, and water scarcity in tropical climates are often inadequately addressed by global tools.

This misalignment has prompted calls for more regionally adaptable rating systems that reflect local environmental conditions, construction techniques, and socio-economic realities [21]. Such tools will have the potential to promote context-sensitive sustainability metrics, such as the use of local materials, passive cooling strategies, and climate-resilient design, while remaining accessible to local stakeholders. By addressing both technical and social dimensions of sustainability, locally developed SBRTs could significantly improve the effectiveness and adoption of sustainable practices in countries such as Nigeria.

In summary, while global SBRTs have played a pivotal role in advancing sustainable construction, their applicability in developing regions remains limited. Their narrow climatic and cultural assumptions often hinder implementation in countries facing different environmental and infrastructural challenges. Developing region-specific tools that incorporate local materials, construction methods, and economic constraints is essential

to ensuring that sustainability frameworks are not only applicable but also impactful in diverse global contexts.



Figure 1. Evolution of SBRTs [35].

2.2. Awareness of Sustainability Building Rating Tool

Awareness of sustainable building rating tools is a major driver of their adoption. There is evidence that levels of awareness of sustainable construction practices and the tools to support them are often found to be insufficient, especially in the developing world [36]. In countries such as the United States, the United Kingdom, and Australia, the utilization of rating tools has been more widespread, partly due to high awareness, government mandates, and robust support systems for sustainable building practices, according to Zhang et al. [35]. Bernardi et al. [37], as shown in Figure 2, explored the geographical coverage of these tools, with Europe leading the scheme, at 54, compared to Africa and the Middle East, which have approximately 0. The literature points to the role of education, training programs, and industry initiatives in raising awareness [1,13]. Professionals in the construction industry, including architects, engineers, contractors, and developers, are often not aware of the variety of tools and their associated benefits. This is a result of poor dissemination of information, especially in developing regions where sustainable construction is not significantly prioritized [13].

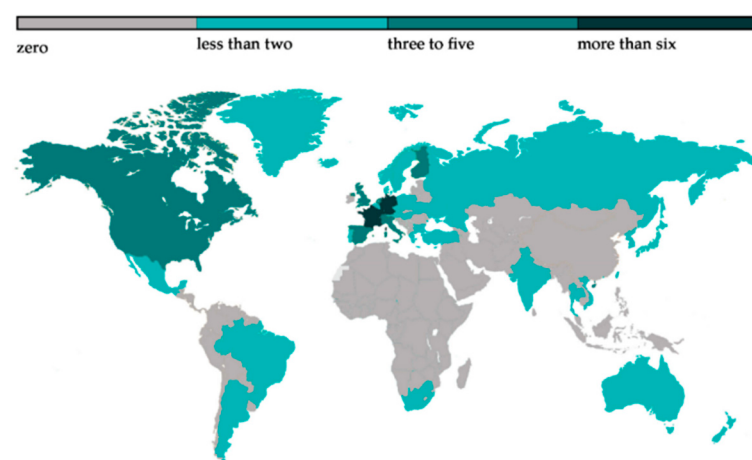


Figure 2. SBRTs' geographical distribution [37].

To address these gaps, experts believe that it is quite possible to enhance awareness significantly by creating targeted education programs and training programs. Incorpora-

tion of sustainability into engineering and architecture courses taught at universities would ensure that upcoming professionals have the required knowledge to implement sustainable building practices [38]. Additionally, industry campaigns showcasing the practical applications of the sustainability tools would prove to be a great aid toward reversing the ongoing misconceptions prevalent among construction professionals and the public as well. Government strategy for sustainability, where rating instruments are required or the monetary benefit for approval, should be the steps to enhance the application and awareness of such tools [25].

2.3. Barriers to Utilization of Sustainable Building Rating Tools

Various authors have reported the benefits of sustainable building rating tools; however, there are still several obstacles preventing their widespread use. One of the biggest challenges is the cost of obtaining certification [39]. Sustainable building rating systems often require a significant upfront investment, including consulting fees, extra labor, and the cost of all the documentation and verification needed for certification [40]. While there are long-term savings, such as lower energy and water bills, cheaper maintenance, and higher property values, the initial costs can be too much, especially for smaller developers [1]. In places where sustainability is not legally required, many people see these costs as an unnecessary burden, which discourages the use of these rating tools [41]. This is particularly so in emerging economies, where capital for construction projects is often limited and short-term economic returns are prioritized [42].

Another barrier is the complexity and time-consuming nature of the certification process [43]. According to the author, sustainable building rating systems have long been accused of having a complex, multi-step process that is too cumbersome for those involved in the construction industry and lacking experience in sustainable design or green building technology. The use of these tools demands coordination by numerous stakeholders, comprehensive documentation of design and construction practices, and regular monitoring, all of which are time and resource intensive [20]. This complexity leads to resistance from developers and contractors who do not have the specialized knowledge to handle it, especially when they are working in a competitive market where time is critical [44]. The extra paperwork and coordination needed to maintain certification may also discourage companies from pursuing these tools [20].

There is also a resistance to change within the construction industry [44]. Many professionals in the field are used to traditional ways of building and may see the move toward sustainability as complicated, unnecessary, or even disruptive. In regions with ambiguous regulations or incentives that favor more sustainable practice, pressure to transition to green building technologies remains minimal [20], with industry practitioners often preferring to stick with what is familiar [1]. In addition, regulatory and legal obstacles can prevent the adoption of sustainable building rating tools, particularly where building codes are not harmonized with the incorporation of sustainable practices [45]. There is no integrated regulatory system for sustainable construction in most nations, and existing laws often fail to provide clear guidelines on implementing or certifying sustainable buildings [39]. This lack of harmonization between jurisdictions makes it difficult for developers to work through certification, and it discourages them further from using it, according to Akadiri [46].

2.4. Drivers of Utilization of Sustainable Building Rating Tools

While barriers exist, there are also several key drivers that are facilitating the increased adoption of sustainable building rating tools. One of the most important factors is the growing concern regarding climate change, dwindling resources, and the environmental impact of traditional construction method [19,47,48]. As global awareness of these issues has risen,

so has the demand for buildings that reduce energy consumption, minimize waste, and limit greenhouse gas emissions [1,49]. Building rating tools offer a structured approach for measuring and mitigating these impacts [22,37]. LEED certification, for instance, examines energy saving, water conservation, and the use of sustainable materials. This can result in buildings with a significantly lower carbon footprint than conventional buildings.

Another important driver is the market demand for green and sustainable buildings [19,47]. The demand is particularly strong in commercial property, where companies desire buildings with sustainability goals that provide long-term financial returns [50]. As a result, respondents see green certification as a way to increase property value and appeal to eco-conscious buyers and tenants, according to the authors.

Olabi et al. [2] also reported the role of financial benefits as a fundamental strategy in encouraging the use of sustainable building rating systems. This has been corroborated in various research studies, which found that although the initial investment may be expensive, sustainable buildings usually produce economic benefits in the long term, mainly through reduced operating costs, higher rental and occupancy rates, as well as better resale values [1,51,52]. Energy-efficient buildings, for instance, contribute to reduced energy and water bills, which can actually conserve long-term operational costs [49]. In addition, the marketability of green-certified buildings tends to lead to premium rental rates, occupancy levels, and resale values [52]. Regulatory pressures from governments have also been reported as a powerful driver [53,54]. Governments worldwide are increasingly implementing regulations that require the development of sustainable and energy-efficient buildings. For instance, building codes in most countries are being revised to include standards for sustainability, such as mandatory energy efficiency or codes for the inclusion of renewable energy [54]. These regulations are very important in encouraging construction stakeholders to utilize sustainable building rating tools and comply with evolving standards.

2.5. Strategic Framework for Enhancing Utilization

To overcome the barriers and enhance the uptake of sustainable building rating tools, a strategic framework has been proposed in Figure 3, based on the findings in the literature. One of the most effective ways to promote sustainability in construction is by including rating systems in national and regional policies. Through regulations, governments can enable a supportive environment for sustainable building by mandating the utilization of rating tools for public sector projects or by offering incentives, such as tax credits, grants, and low-interest loans, for projects that meet sustainability standards. This should be clear and consistent to make it easier for businesses and construction professionals to commit to sustainable building.

Another key strategy is the formation of public–private partnerships (PPPs). The partnerships can be utilized to offer the needed infrastructure, resources, and networks that will enhance the uptake of sustainable building rating tools. For example, PPPs can finance research in sustainable building technologies, offer educational resources, and develop training programs for building professionals. Such collaborations also make it possible to share knowledge and best practices among the stakeholders, helping to remove adoption barriers and simplify the certification process.

Tailoring sustainable building rating tools to local contexts is another critical strategy. While well-known systems, such as LEED, set international standards, they may not always address specific regional challenges. For instance, in areas where water is scarce, sustainability guidelines should focus more on water conservation and low-impact technologies. This ensures that they are more relevant and effective.

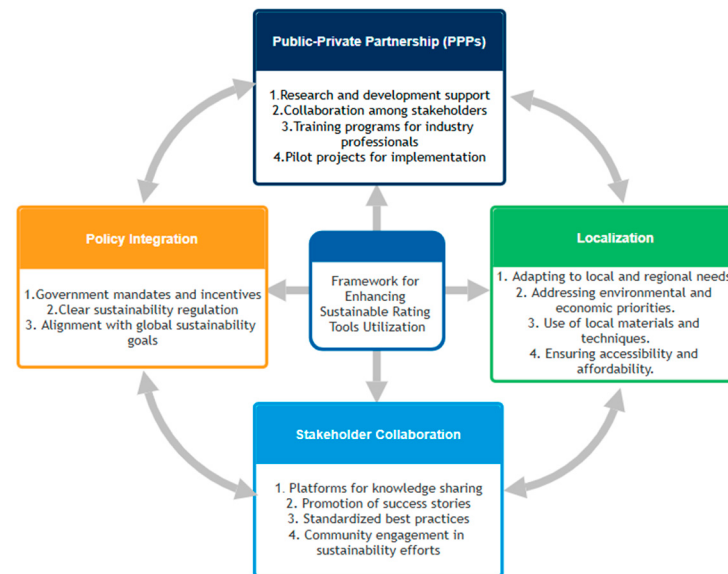


Figure 3. Strategic framework for enhancing SBRT utilization (created by the author).

Finally, encouraging cooperation between diverse stakeholders—construction experts, policy-makers, and the public at large—is vital in the development of sustainable construction practices. Information exchange platforms, sharing of good examples of successful cases, and the transmission of best practices can help foster a well-informed and inspired construction community. By building a strong network of stakeholders committed to sustainability, the industry can overcome obstacles and ensure that sustainable building rating tools are utilized effectively across different sectors and regions. This framework, therefore, forms the basis of investigating the utilization of SBRTs in Nigeria’s construction industry.

3. Research Method

An explanatory sequential mixed-methods design was employed in this study to gain a comprehensive understanding of the utilization of Sustainable Building Rating Tools (SBRTs) within Nigeria’s construction sector. This research design—successfully applied in prior studies, such as Marcel-Okafor [55] and Chauhan et al. [56]—was chosen for its ability to integrate both quantitative and qualitative data, which is essential for exploring complex and multifaceted research questions [57], such as those surrounding the adoption of SBRTs. The study began with the collection and analysis of quantitative data to identify overarching patterns and trends. This was followed by a qualitative phase, designed to further explore and explain the quantitative findings. The sequential nature of this approach ensured that the qualitative investigation was informed by and targeted toward the specific issues emerging from the initial phase, thereby enabling a deeper and more focused examination of the key factors influencing SBRT adoption.

The study population consisted of major stakeholders in the building construction industry, such as registered architects who are members of the Nigerian Institute of Architects (NIA) and the Architects Registration Council of Nigeria (ARCON). The other stakeholders were members of the Nigerian Institute of Building (NIOB) and the Association of Consulting Engineers of Nigeria (ACEN) and representatives of large-scale construction companies registered with the Council for the Regulation of Engineering in Nigeria (COREN). The real property developers who engaged in sustainable building projects were also covered by the study.

A questionnaire-based survey was conducted between October and December 2024 in Lagos, Abuja, and Port Harcourt. These cities were selected because of their significance in Nigeria’s architectural and construction landscape. The inclusion of these cities guarantees

a plethora of opinions on the adoption of SBRTs within Nigeria's built environment. The survey sampled 98 practitioners and 24 respondents in follow-up interviews. The questionnaire was organized into two general sections. The first section collected demographic and professional background information, including respondents' years of experience, project types, and utilization and awareness of SBRTs. The second part determined the drivers and barriers to the adoption of SBRTs, quantified using the Likert Scale. For the qualitative aspect, semi-structured interviews were employed to gain deeper insights into professionals' awareness of SBRTs, implementation challenges, and their usage. The interviews were guided by a structured protocol developed from the survey results and literature themes. Key questions focused on (1) awareness and experience with SBRTs, (2) perceived challenges to their use, (3) the role of government and market incentives, (4) suggestions for tool simplification, and (5) future prospects. Interviews lasted 15–20 min and were conducted in person and online with purposively selected participants from diverse professional backgrounds. The interview data were transcribed and thematically analyzed using Taguette, an open-source qualitative analysis tool. Manual coding was applied using a predefined framework encompassing technological, environmental, and socio-economic barriers, as well as key drivers of SBRT utilization. This structured approach enabled transparent reporting and ensured that qualitative insights aligned with the quantitative findings.

4. Results and Discussion

The validity and reliability of the questionnaire were checked to ensure the accuracy and consistency of the research results. Validity of an instrument represents the degree to which the questions examine the element it is intended to measure. This was performed using Cronbach's alpha in SPSS (version 30.0.0). The overall Cronbach's alpha for this study's responses was 0.882, which is higher than the standard measure of 0.7 [58], indicating an outstanding evaluation of the test items' reliability and consistency. The questions answered by the participants in the questionnaire and their results are presented in Table 1.

Table 1. Test results for validity and reliability.

Test Item	Coefficient Alpha	Sub-Values
Level of awareness and utilization of SBRTs	0.729	5
Drivers of SBRTs utilization	0.856	11
Barriers of SBRTs utilization	0.720	11
Overall Cronbach's alpha value	0.882	27

4.1. Awareness and Utilization of SBRTS

The study established that 72.4% of respondents were aware of the Sustainable Building Rating Tools (SBRTs), yet only 39.8% had utilized them, as shown in Table 2. This high disparity indicates that awareness does not necessarily translate to high utilization. Analysis by profession revealed that sustainability consultants had the highest awareness (93.3%) and utilization (73.3%), whereas suppliers had the lowest awareness and utilization, at 16.7% and 0%, respectively. Percentages of utilization also increased with years of experience, to over 50% for those with more than 16 years of experience. A moderate positive correlation ($r = 0.31$, $p = 0.004$) was found between awareness and utilization of SBRTs, supporting findings by Agyekum et al. [28] and Dalirazar and Sabzi [59], which emphasized that public awareness is a key factor in driving demand for sustainable buildings. A further analysis also indicated that experience is correlated to utilization ($r = 0.28$, $p = 0.012$), indicating that more experienced professionals are more likely to use these tools.

Table 2. Awareness and utilization of sustainable building rating tools (SBRTs).

Category	Total Respondents (n)	Awareness (n %)	Utilization (n %)
Overall	98	71 (72.4%)	39 (39.8%)
By Profession			
Architects	30	25 (83.3%)	15 (50.0%)
Engineers	25	18 (72.0%)	9 (36.0%)
Sustainability Consultants	15	14 (93.3%)	11 (73.3%)
Developers	12	8 (66.7%)	4 (33.3%)
Contractors	10	5 (50.0%)	2 (20.0%)
Suppliers	6	1 (16.7%)	0 (0.0%)
By Experience			
0–5 years	20	13 (65.0%)	6 (30.0%)
6–10 years	28	20 (71.4%)	9 (32.1%)
11–15 years	25	19 (76.0%)	11 (44.0%)
16–20 years	15	12 (80.0%)	8 (53.3%)
21+ years	10	7 (70.0%)	5 (50.0%)
Correlation Analysis		<i>r</i>	<i>p-value</i>
Awareness vs. Utilization	98	0.31	0.004
Experience vs. Utilization	98	0.28	0.012

A binomial logistic regression was conducted to determine the predictability of socio-economic variables, such as education and income level, company size, type of employer, type of projects, government regulations and incentives, organizations with SBRTS awareness and utilization, as shown in Table 3. The results indicate that the high-income group ($\geq \text{₦}5$ million naira/year) is highly correlated with both awareness and utilization of SBRTs ($r = 0.41$), showing a high degree of association between financial capacity and the adoption of SBRTs. Respondents with a university degree or higher show greater awareness and utilization of SBRTs ($r = 0.38$), which suggests that education plays a role in the adoption of sustainable practices. Larger companies (50+ employees) are more likely to utilize SBRTs, with a higher correlation coefficient ($r = 0.45$), indicating that larger firms have more resources and capacity for SBRT adoption. Government or multinational organizations show a higher percentage of SBRT utilization (66.7%) and a strong correlation ($r = 0.43$), emphasizing that these organizations might be more engaged in sustainable practices due to regulatory incentives.

Table 3. Statistical analysis of socio-economic variables affecting SBRT utilization (N = 98).

Socioeconomic Variable	Total Respondents (n)	Awareness (n, %)	Utilization (n, %)	Correlation (r)	95% CI for r	p-Value	95% CI for p-Value
1. Education Level							
Secondary Education or Below	40	25 (62.5%)	10 (25.0%)	0.22	(0.02, 0.42)	0.045	(0.02, 0.09)
University Degree or Higher	58	45 (77.6%)	30 (51.7%)	0.38	(0.18, 0.57)	0.003	(0.001, 0.02)
2. Income Level							
High Income ($\geq$ ₦5 million/year)	38	32 (84.2%)	24 (63.2%)	0.41	(0.21, 0.61)	0.001	(0.0001, 0.01)
Low to Moderate Income ($<$ ₦5 million/year)	60	40 (66.7%)	16 (26.7%)	0.31	(0.11, 0.51)	0.003	(0.01, 0.05)
3. Company Size							
Large Companies ($>$ 50 employees)	53	44 (83.0%)	30 (56.6%)	0.45	(0.30, 0.60)	0.001	(0.0001, 0.004)
Small to Medium Companies ($<$ 50 employees)	45	29 (64.4%)	10 (22.2%)	0.30	(0.10, 0.50)	0.004	(0.01, 0.05)
4. Type of Projects							
Residential Projects	50	35 (70.0%)	14 (28.0%)	0.29	(0.08, 0.50)	0.015	(0.02, 0.06)
Commercial Projects	38	32 (84.2%)	22 (57.9%)	0.47	(0.27, 0.67)	0.001	(0.0001, 0.02)
Mixed-Use Projects	10	8 (80.0%)	6 (60.0%)	0.41	(0.15, 0.62)	0.002	(0.01, 0.04)
5. Type of Employer							
Government or Multinational	33	29 (87.9%)	22 (66.7%)	0.43	(0.25, 0.61)	0.002	(0.0001, 0.03)
Private Sector (Local Developers)	65	43 (66.2%)	14 (21.5%)	0.31	(0.16, 0.46)	0.001	(0.0001, 0.04)
6. Government Regulations & Incentives							
Strong Regulations & Incentives	53	46 (86.8%)	33 (62.3%)	0.47	(0.30, 0.64)	0.001	(0.0001, 0.003)
Weak Regulations & Incentives	45	24 (53.3%)	7 (15.6%)	0.22	(0.02, 0.41)	0.03	(0.02, 0.08)

4.2. Barriers to SBRT Utilization

This study examines the key barriers hindering the utilization of Sustainable Building Rating Tools (SBRTs) in Nigeria. Drawing from both literature and empirical data, the analysis categorizes these barriers into three main groups: technological, environmental, and socio-economic. The identified barriers were validated through a combination of quantitative analysis and qualitative interviews with professionals across the construction industry. To enhance the clarity and comparability of qualitative insights, a precoding structure was applied to the interview data. Stakeholder responses were systematically grouped by professional roles—architects, engineers, sustainability consultants, developers, contractors, and suppliers. This approach allowed for a more nuanced understanding of how each professional group perceives and experiences SBRT-related challenges. For example, developers and contractors frequently highlighted economic constraints, such as the high cost of certification and limited financial incentives. Architects and consultants often pointed to technical issues, including tool complexity and lack of alignment with local materials or climate. Engineers emphasized challenges such as the absence of localized energy efficiency standards and difficulties integrating SBRTs into conventional building systems. These profession-specific perspectives added depth to the analysis and are reflected in Table 4.

Table 4. Barriers to SBRT utilization from interview findings.

Barrier	Category	Description/Interview Findings	% Reporting Barrier	RII	Stakeholder Perspective
High Certification Costs	Technological	The certification cost for SBRT is too high to make it commonplace. Respondents indicated that SBRT certification price is too costly for most and hence restricts adoption. A lack of incentives or government sponsorship was the overriding issue raised.	87%	0.85	Developers, Contractors, Engineers, Architects
Complexity of Tools	Technological	SBRTs are perceived as too technical or complex, requiring intensive training. A significant number of the respondents view SBRTs as difficult to use due to complex interfaces and intensive training. Simpler versions of the tools are being demanded	84%	0.78	Architects, Consultants, Engineers, Developers
Dependence on Foreign Experts	Technological	Overdependence on foreign experts is expensive and pushes back implementation. Respondents highlighted the challenge of relying on foreign experts for sustainability assessment, which is expensive and pushes back project timelines. Local expertise is needed.	79%	0.74	Consultants, Engineers, Developers
Lack of Localized Tools	Technological	Existing SBRTs are not appropriate to Nigeria's local construction materials, practices, and regulatory conditions. The majority of respondents indicated that SBRTs are not customized to the Nigerian environment, and therefore it is difficult to apply the tools effectively due to different climates and construction practices.	74%	0.72	Architects, Engineers, Consultants

Table 4. Cont.

Barrier	Category	Description/Interview Findings	% Reporting Barrier	RII	Stakeholder Perspective
Limited Digital Infrastructure	Technological	Unreliable digital platforms and tools impede SBRT application and monitoring. The lack of stable internet and platform access was mentioned as a barrier to effective use of tools.	60%	0.65	Engineers, Developers, Contractors
Poor Integration with Local Practices	Technological	Tools fail to smoothly integrate with local building systems or regulation standards in Nigeria. Some of the participants mentioned the problem of integrating SBRTs with building codes and local practices.	65%	0.67	Architects, Engineers
Misalignment with Local Climate	Environmental	SBRTs are usually made for temperate climates and do not take into account Nigeria's tropical climate. Respondents stated that SBRTs are developed for other climates than Nigeria's tropical environment, and that existing available criteria do not completely account for heat, humidity, or local cooling requirements. making them less relevant and effective.	72%	0.70	Architects, Consultants, Engineers
Shortage of Local Sustainability Data	Environmental	Inaccessibility of local environmental performance data for Nigeria inhibits sustainability measurement. Some of the respondents pointed out that the lack of local sustainability data impeded good decision making according to SBRT recommendations.	55%	0.60	Consultants, Engineers
Shortage of Energy Efficiency Standards	Environmental	Nigeria-specific energy efficiency standards are lacking, limiting the energy-based SBRT criteria's feasibility. No locally apparent energy efficiency standard exists, so it is difficult to achieve energy-efficient measures that are SBRT-consistent.	68%	0.67	Engineers, Consultants
Limited Market Demand	Socio-Economic	Low demand and awareness among consumers for green buildings reduce developer incentives. Respondents indicated that market demand for green buildings is low and that clients prioritize cost above sustainability. Consumer education is required to increase demand for green buildings.	68%	0.66	Developers, Contractors, Suppliers
Cultural Resistance to Change	Socio-Economic	Resistance to adopting new technology and conventional means of construction deters SBRT adoption. Respondents are faced with resistance by stakeholders opposed to using new, green technologies as opposed to conventional means of construction. Cultural resistance significantly contributes to deterrence.	74%	0.71	Contractors, Developers

Table 4. Cont.

Barrier	Category	Description/Interview Findings	% Reporting Barrier	RII	Stakeholder Perspective
Inadequacy of Government Incentives	Socio-Economic	Absence of government-backed incentives or policies dissuades motivation toward seeking certification. The majority of respondents stated that the lack of government financial incentives, including tax rebates or subsidies, makes adoption of SBRTs less financially attractive.	63%	0.60	Developers, Contractors, Consultants, Engineers
Limited Awareness and Education	Socio-Economic	The majority of professionals are not adequately aware of SBRT tools and benefits, which limit their use in projects. There is a general unawareness about SBRTs and their benefits. Respondents believe that there should be additional training and education programs to increase awareness and adoption.	64%	0.62	Suppliers, Developers
Poor National and Local Waste Infrastructure	Environmental	Low uptake of sustainable waste practices encouraged in SBRTs because of poor national and local waste infrastructure. Respondents showed that poor waste management systems in Nigeria discourage the adoption of sustainable building practices.	59%	0.58	Contractors, Consultants
Lack of Local Expertise	Socio-Economic	Low availability of local professionals with sustainability assessment training forces the use of foreign consultants. Respondents emphasized the need to develop local expertise for sustainability assessments to prevent overreliance on foreign consultants.	62%	0.59	Consultants, Engineers
Economic Instability	Socio-Economic	Instability of the global economy lowers the readiness to invest in long-term sustainability projects. Participants mentioned inflation, insecurity, and financial unreliability as the reasons they did not adopt sustainable practices	50%	0.61	Developers, Contractors

4.2.1. Technological Barriers

A significant technological barrier identified is the high cost of certification. The statistical analysis shows that high certification costs significantly reduce the likelihood of adopting SBRTs, with an adjusted odds ratio of 0.50 (95% CI: 0.25–0.99, $p = 0.045$). This is also corroborated by results from the interviews, in which 87% of the respondents mentioned the very high cost of certification. It was also indicated that these costs are not necessary, especially where clients value affordability more than sustainability. This is consistent with the literature, which indicates that high initial costs are a significant barrier to the implementation of sustainable construction in developing economies [60–62]. The

complexity of the tools that are utilized in sustainable building analysis also emerged as a significant technological barrier.

The adjusted odds ratio was high at 0.35 (95% CI: 0.14–0.76, $p = 0.010$). During follow-up interviews, 84% of participants identified that the tools are often too complicated, requiring expert training and knowledge. This finding echoes the literature that points to the challenge of complicated certification processes that make SBRTs difficult to implement, particularly in regions lacking skilled professionals [1]. Respondents expressed a preference for simpler, more intuitive tools that could make the certification process more accessible.

The dependence on foreign experts for SBRT implementation was also highlighted as a key technological barrier. The statistical data in Table 5 show a significant reduction in SBRT utilization due to this dependency, with an adjusted odds ratio of 0.37 (95% CI: 0.15–0.78, $p = 0.010$). Interviews revealed that 79% of respondents are frustrated by the reliance on foreign expertise, which increases both the cost and duration of SBRT certification. These findings align with previous research, which indicates that the high cost of foreign consultants is a significant barrier in many developing countries [61,63,64].

Table 5. Statistical analysis of barriers to SBRT utilization.

Barrier	Category	Unadjusted OR	95% CI	<i>p</i> -Value	Adjusted OR	95% CI	<i>p</i> -Value
High Certification Costs	Technological	0.58	0.35–0.97	0.045	0.50	0.25–0.99	0.045
Complexity of Tools	Technological	0.43	0.22–0.84	0.011	0.35	0.14–0.76	0.010
Lack of Localized Tools	Technological	0.67	0.33–1.36	0.288	0.63	0.29–1.44	0.299
Limited Digital Infrastructure	Technological	0.53	0.23–1.16	0.115	0.46	0.18–1.14	0.093
Dependence on Foreign Experts	Technological	0.41	0.19–0.84	0.014	0.37	0.15–0.78	0.010
Poor Integration with Local Practices	Technological	0.61	0.30–1.28	0.197	0.54	0.22–1.21	0.142
Misalignment with Local Climate	Environmental	0.52	0.26–1.04	0.067	0.47	0.22–0.96	0.039
Lack of Energy Efficiency Standards	Environmental	0.48	0.24–0.96	0.039	0.45	0.21–0.91	0.027
Inadequate Waste Management Systems	Environmental	0.37	0.16–0.83	0.017	0.33	0.12–0.74	0.008
Lack of Local Sustainability Data	Environmental	0.59	0.28–1.27	0.183	0.53	0.23–1.23	0.137
Economic Instability	Socio-Economic	0.61	0.29–1.28	0.186	0.54	0.24–1.18	0.122
Limited Market Demand	Socio-Economic	0.50	0.23–1.08	0.081	0.44	0.18–0.97	0.041
Cultural Resistance to Change	Socio-Economic	0.47	0.22–0.98	0.041	0.42	0.17–0.92	0.032
Lack of Government Incentives	Socio-Economic	0.51	0.26–1.04	0.070	0.46	0.20–1.08	0.075
Limited Awareness and Education	Socio-Economic	0.62	0.31–1.25	0.195	0.55	0.24–1.15	0.127
Lack of Local Expertise	Socio-Economic	0.58	0.28–1.20	0.145	0.52	0.22–1.11	0.097

4.2.2. Environmental Barriers

The analysis in Table 5 found misalignment with the local climate as a significant environmental barrier. The adjusted odds ratio for the barrier was 0.47 (95% CI: 0.22–0.96, $p = 0.039$), which suggests that SBRTs are not sufficiently adapted to local conditions. In the follow-up interview, more than two-thirds (72%) pointed out that the tools do not consider Nigeria's tropical climate, which makes them less effective. This finding is supported by the

literature, which found that SBRTs built for temperate environments may not be suitable for tropical nations, where building designs must account for factors such as humidity and heat [34,65,66].

Another significant environmental barrier is the lack of energy efficiency standards. Statistical analysis indicates that the absence of such standards has a significant impact on SBRT adoption, with an adjusted odds ratio of 0.45 (95% CI: 0.21–0.91, $p = 0.027$). In the interviews, 68% of the respondents noted that without clear, locally relevant energy efficiency standards, it is difficult to meet the SBRT criteria. The lack of such standards has been reported in the literature [67,68], where it is argued that local governments in many developing countries have yet to implement comprehensive energy efficiency regulations, which slows down the adoption of sustainable building rating tools.

4.2.3. Socio-Economic Barriers

The limited market demand for sustainable buildings emerged as a critical socio-economic barrier, with an adjusted odds ratio of 0.44 (95% CI: 0.18–0.97, $p = 0.041$). It was revealed in the interviews that many clients prioritize cost over sustainability, making the market for sustainable buildings relatively small. This is consistent with the literature, which indicates that low market demand for sustainable buildings in developing economies is a significant obstacle to the widespread adoption of SBRTs [6,69–73].

The cultural resistance to change was another socio-economic barrier identified in both the statistical and interview data. The adjusted odds ratio for this barrier was 0.42 (95% CI: 0.17–0.92, $p = 0.032$), implying that cultural factors play a significant role in the uptake of SBRTs. Interviews revealed that 74% of respondents believe that traditional building practices are deeply ingrained in local culture, and there is significant resistance to adopting new, unfamiliar methods. This finding aligns with the literature [4,74,75], which suggests that cultural resistance to sustainability practices is common in most developing nations where traditional methods are greatly valued.

Utilization of SBRTs is also affected by a lack of government incentives, with an adjusted odds ratio of 0.46 (95% CI: 0.20–1.08, $p = 0.075$). While this barrier was marginally significant, 63% of respondents in the interviews highlighted the lack of governmental support in the form of subsidies or tax breaks. This discourages construction stakeholders from applying for SBRT certification because the cost of certification becomes ever more difficult to justify in the absence of financial rewards. The literature on the adoption of sustainable buildings in developing countries consistently underscores the importance of government incentives in overcoming barriers to sustainability [1,73,76].

4.3. Drivers of SBRTs

In the context of the Nigerian construction industry, government regulations (Adjusted OR = 1.74, 95% CI = 1.10–2.72, $p = 0.019$), which had the highest relative importance index (RII) of 0.85, constitute a significant factor, driving the utilization of sustainable building rating tools (SBRTs) as seen in Table 6. Government regulation provides a clear regulatory framework in encouraging building professionals to shift toward sustainable practices and has proven effective in driving sustainability in buildings, ensuring consistency and universal compliance [77]. The effectiveness is also demonstrated by the Indian National Building Code, which acts as a driving force in incorporating energy-efficient standards in buildings [78], as it can mandate compliance and stimulate incentives for building stakeholders [1].

Table 6. Drivers of the utilization of SBRT.

Driver	Very Important (5)	Important (4)	Moderately Important (3)	Slightly Important (2)	Unimportant (1)	Total Number	A×N	RII	Unadjusted OR	95% CI	p-Value	Adjusted OR	95% CI	p-Value	Rank
Government regulations	45	35	10	5	3	98	485	0.85	1.85	1.45–2.25	0.001	1.72	1.20–2.34	0.003	1
Environmental benefits of SBRT	40	30	15	7	6	98	460	0.80	1.72	1.28–2.14	0.002	1.60	1.14–2.05	0.006	2
Reduced cost of SBRT	30	25	20	10	5	98	420	0.73	1.52	1.10–1.96	0.040	1.46	1.05–1.88	0.025	3
The interest of building professional/clients in SBRT	35	20	25	10	8	98	410	0.71	1.40	1.05–1.80	0.041	1.38	1.04–1.76	0.049	4
Technical knowledge/training	28	20	18	15	7	98	390	0.68	1.28	0.96–1.58	0.168	1.20	0.91–1.55	0.233	5
Recognition of Sustainable Building achievements	30	22	20	10	8	98	365	0.63	1.10	0.85–1.30	0.405	1.05	0.75–1.22	0.563	6
Promotion of the corporate green image	28	20	18	15	8	98	330	0.50	0.95	0.70–1.25	0.679	0.92	0.67–1.20	0.463	7
Availability of financial incentives	45	30	12	8	3	98	425	0.74	1.75	1.38–2.10	0.001	1.68	1.24–2.04	0.004	8
Access to sustainable building materials	38	25	18	12	5	98	435	0.75	1.65	1.20–2.10	0.004	1.60	1.10–2.05	0.020	9
Support from local institutions	32	20	15	20	11	98	385	0.67	1.55	1.15–1.95	0.009	1.50	1.05–1.85	0.012	10

The environmental benefits of SBRTs also emerged as a significant driver (Adjusted OR = 1.46, 95% CI = 1.01–2.11, $p = 0.045$), with an RII of 0.80. The respondents were of the view that the utilization of SBRTs would result in the mitigation of many environmental problems, such as energy use and the carbon footprint. This is echoed by global research that focuses on sustainability in building and construction processes as a way to combat climate change [3,79,80]. A study conducted by Zakaria and Ahram [81] listed the environmental benefits of sustainable buildings, including innovative environmental solutions, conservation of resources and environment, reduction of harmful environmental impacts of buildings, and preservation of the environment.

Additionally, the reduced cost of SBRTs (Adjusted OR = 1.32, 95% CI = 0.97–1.85, $p = 0.071$), with an RII of 0.73, emerged as an influential driver. While this is not as strong as regulatory and environmental benefits, the reduced financial burden was noted as an important factor in encouraging the use of SBRTs. This finding supports the existing literature, which suggests that cost-reduction strategies are essential to overcoming the financial barriers that hinder the use of sustainable building tools [62].

The interest of building professionals and clients in SBRT (Adjusted OR = 1.24, 95% CI = 0.88–1.75, $p = 0.215$) with an RII of 0.71 reflects a moderate driver. While it shows that the interest is growing, its influence is less pronounced relative to the regulatory or environmental benefits. This aligns with the submission of Kibert [21], who stated that in many developing economies, the utilization of SBRTs is still low due to limited awareness and the absence of strong market demand. Therefore, more sensitization, public engagement, and supportive government policies are needed to drive up the interest in and commitment to sustainability in the built environment.

The availability of technical knowledge and training (Adjusted OR = 1.37, 95% CI = 0.96–1.96, $p = 0.083$), with an RII of 0.68, indicates that technical capacity building is an important, although less prioritized, driver of SBRT utilization. The slow uptake of these important factors, which is due to a lack of expertise and training, has been reported in this study and several other studies [1,82]. Professionals emphasized training and certification programs to ensure a skilled pool of professionals who can administer SBRT competently.

Recognition of sustainable building achievements (Adjusted OR = 1.12, 95% CI = 0.80–1.58, $p = 0.478$) and corporate green image promotion (Adjusted OR = 1.06, 95% CI = 0.75–1.51, $p = 0.725$), with RIIs of 0.63 and 0.50, respectively, were ranked lower among the drivers. While these factors are still relevant, they are apparently less salient in driving the adoption of SBRTs. This suggests that building professionals may prioritize regulatory compliance and environmental responsibility over branding opportunity, which is consistent with other studies in that financial and regulatory incentives are more persuasive than reputational incentives [14,83,84].

In summary, the findings point toward the fact that while different factors influence the utilization of SBRTs, government regulation and environmental benefits are the strongest drivers. The adjusted odds ratios further confirm the significance of regulatory frameworks, reduced costs, and environmental considerations as central to ensuring the promotion of SBRT utilization in Nigeria. These findings validate the literature and emphasize the need for a combination of regulatory support, financial incentives, and training initiatives in order to foster the widespread adoption of sustainable construction practices in Nigeria.

5. Discussion

This study provides valuable insights into the utilization of Sustainable Building Rating Tools (SBRTs) in Nigeria's construction industry, highlighting both the barriers and drivers that impact their adoption. A key finding from the research is the significant gap between awareness and actual utilization of SBRTs, with 72.4% of respondents aware

of these tools but only 39.8% utilizing them. This suggests that while the tools are recognized within the industry, their adoption is hindered by various challenges, many of which are deeply rooted in Nigeria's unique socio-economic and environmental context. Similar findings have been observed in other regions, where awareness of sustainable practices is often high, but practical implementation is hindered by barriers such as cost and complexity [37,45,60,69].

One of the main barriers identified in this study is the high cost of certification, which continues to be a significant deterrent for construction professionals and developers in Nigeria. Despite the long-term benefits of sustainable buildings, such as reduced operational costs and higher property values, the initial investment required for SBRT certification remains unaffordable for many. This is especially problematic for smaller developers who may lack the financial capacity to absorb the upfront costs associated with certification. Previous studies have also highlighted the significant financial barriers to adopting green building certification, particularly in emerging economies [42,62]. The findings also suggest that the complexity of the tools further exacerbates the issue. SBRTs require specialized knowledge and resources, and many professionals in Nigeria, particularly those working with smaller firms, may find it difficult to navigate the intricate certification processes. Simplifying the tools and making them more accessible to professionals with limited experience in sustainable practices could help address this barrier. This aligns with literature indicating that tool complexity is a common deterrent to adoption, especially in developing countries [20,43].

The study also revealed that the existing SBRTs are often misaligned with Nigeria's tropical climate. Most tools were developed for temperate climates, where energy efficiency and environmental conditions differ greatly from those in tropical regions. This misalignment limits the effectiveness and applicability of SBRTs in Nigeria, where issues such as high humidity, heat, and the need for passive cooling are critical. A similar challenge has been noted in other countries, where SBRTs developed for temperate climates do not adequately address the specific needs of tropical or hot-arid environments [34,66]. To ensure the relevance of SBRTs, it is essential that they are adapted to local climate conditions [85], taking into account the specific challenges faced by buildings in Nigeria. The development of localized rating systems that consider the country's environmental and regulatory context could significantly enhance the effectiveness of SBRTs.

In addition to environmental and technical challenges, socio-economic factors also play a crucial role in the adoption of SBRTs. The study highlights the low market demand for sustainable buildings, as many clients prioritize cost over sustainability. This reflects a broader trend in developing economies, where the economic feasibility of projects often takes precedence over long-term sustainability goals [6,70]. Despite the growing awareness of climate change and environmental degradation, the economic pressures faced by developers and clients in Nigeria result in a preference for conventional, cost-effective construction methods. Previous research has similarly shown that in many developing nations, the market for green buildings remains limited, which hinders the widespread adoption of SBRTs [1,2]. Furthermore, the cultural resistance to new technologies and unfamiliar construction methods remains a significant obstacle. Many stakeholders are accustomed to traditional building practices and are reluctant to embrace sustainable technologies, which they perceive as complex and costly. Overcoming this resistance will require a concerted effort to change attitudes through education, public awareness campaigns, and government incentives that demonstrate the tangible benefits of sustainable construction. Cultural resistance to new practices has been a recurring barrier in many developing countries [74,75].

However, not all aspects of the study were negative. Several drivers were also identified that could facilitate the increased adoption of SBRTs. Government regulations emerged as the most powerful driver, with the study showing that regulatory frameworks are key to promoting the use of sustainable building practices. In many countries, including Nigeria, regulatory mandates for energy-efficient buildings and green certifications can drive industry-wide change. The effectiveness of regulations in driving the adoption of sustainable building practices has been demonstrated in various contexts [77,78]. The study suggests that the Nigerian government should introduce or strengthen regulations that mandate sustainable construction practices, particularly for public sector projects, and provide incentives, such as tax credits or subsidies, to make certification more affordable. These regulatory measures could help create a more conducive environment for the uptake of SBRTs.

The environmental benefits of SBRTs also stand out as a significant driver. Many professionals recognized that these tools can play a key role in mitigating the environmental impact of the construction industry by reducing energy consumption, carbon emissions, and waste. As environmental concerns become more pressing globally, the demand for green buildings is likely to increase, further encouraging the adoption of SBRTs. A study by Hafez et al. [80] highlights that green buildings can significantly reduce energy consumption and carbon footprints, reinforcing the environmental value of SBRTs. Additionally, the financial incentives associated with SBRTs, such as lower operating costs and higher property values, also played a role in driving their adoption. Respondents indicated that while the initial costs were a barrier, the long-term financial benefits of using SBRTs were compelling, particularly for larger firms and multinational organizations. Financial incentives have been identified as a critical factor in overcoming adoption barriers in various studies [51,52].

Finally, the interest in SBRTs among building professionals and clients is slowly growing. The study found that as awareness increases, so does interest in sustainable building practices. However, this driver remains less influential compared to government regulations and environmental concerns, suggesting that more public engagement and education are needed to foster a deeper commitment to sustainability in the construction industry. The slow uptake of SBRTs due to limited awareness and market demand has been reported in several studies [21,84]. Training programs for professionals, the inclusion of sustainability in academic curricula, and awareness campaigns aimed at both industry stakeholders and the general public could help further cultivate interest and support for SBRTs.

6. Conclusions and Recommendations

The study has provided valuable insights into the utilization of Sustainable Building Rating Tools (SBRTs) within Nigeria's construction industry. Despite a relatively high level of awareness (72.4%) of these tools among industry professionals, the actual usage remains low, with only 39.8% of respondents actively applying them. This disparity indicates a significant gap between awareness and practice, suggesting that while there is knowledge of the tools, factors such as high certification costs, tool complexity, and a lack of local adaptation have hindered their broader adoption. The findings also point to a critical dependence on socio-economic factors, including professional experience, income levels, and educational background, which significantly influence the likelihood of adopting SBRTs. Additionally, market demand for green buildings remains low, and there is considerable cultural resistance to adopting sustainable practices, which further exacerbates the slow uptake of SBRTs.

The research also highlights several environmental and socio-economic challenges that prevent the widespread use of SBRTs. Misalignment with Nigeria's tropical climate, cou-

pled with inadequate local sustainability data, makes existing rating tools less effective in addressing the country's unique construction needs. Moreover, regulatory and legal barriers continue to complicate the integration of sustainability practices into Nigeria's building codes. Without significant incentives, such as tax credits or government-backed subsidies, the financial burden associated with SBRT certification remains prohibitive for many stakeholders, particularly smaller developers and contractors. Despite these challenges, key drivers for adoption, such as government regulations and growing environmental awareness, offer hope for improving SBRT utilization in the future.

In conclusion, the study underscores the need for more targeted efforts from the government, private sector, and professional organizations to increase the adoption of sustainable building practices through SBRTs. There is a clear need for localized and simplified SBRTs that align with Nigeria's environmental and economic context. Additionally, raising awareness, particularly through education and training programs, will help to overcome the knowledge gap and reduce resistance to change. Addressing the financial barriers, particularly by offering incentives to encourage green building certifications, will also go a long way in promoting the adoption of SBRTs. By aligning government policies with sustainable construction goals and creating an environment that fosters education, incentives, and local expertise, Nigeria can pave the way for a more sustainable and resilient construction industry.

Funding: This research received no external funding.

Institutional Review Board Statement: Not Applicable.

Informed Consent Statement: Not Applicable.

Data Availability Statement: The original contributions presented in this study are included in the article. Further inquiries can be directed to the corresponding author.

Acknowledgments: This article benefited from the use of artificial intelligence tools (ChatGPT and QuillBot) to assist with text reformulation and translation, solely for the purpose of enhancing linguistic clarity.

Conflicts of Interest: The author declares no conflicts of interest.

Abbreviations

The following abbreviations are used in this manuscript:

SBRTs	Sustainable Building Rating Tools
PPPs	Public–Private Partnerships

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