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Green Building Assessment Systems in South Africa: Key Indicators and Implementation Barriers

Mayowa Ogungbe[1], Matthew Ikuabe[2], Clinton Aigbavboa[1], and Ayodeji Oke[1]

[1] SARChI in Sustainable Construction Management and Leadership in the Built Environment, Faculty of Engineering and the Built Environment, University of Johannesburg, South Africa
[2] School of Construction Economics and Management, University of the Witwatersrand, South Africa

ogungbemayowa@yahoo.com

Abstract

Green Building Assessment Systems (GBAS) serve as standardised tools for evaluating environmental performance and promoting sustainability in the construction industry. In South Africa, the urgency for sustainable building practices is heightened by escalating energy demands, water scarcity, and climate change challenges. Despite increasing awareness, the adoption of GBAS remains limited and inconsistent. This study investigates the key indicators employed in GBAS and examines the barriers to their effective implementation within the South African context. A structured questionnaire, informed by existing literature, was administered to construction professionals in Gauteng Province. Sixty valid responses were analysed using Mean Item Score, Standard Deviation, and One-Sample T-test. The reliability of the research instrument was confirmed with a Cronbach's alpha of 0.924, indicating strong internal consistency. Findings indicate that energy efficiency, carbon emission reduction, and water efficiency are the most critical indicators in current green building evaluations. These reflect the growing prioritisation of resource optimisation and environmental responsibility. Also, the study identifies significant barriers of GBAS to include high investment costs, policy enforcement gaps, government support deficiencies, and implementation uncertainties. These challenges highlight the disconnect between awareness and practice, suggesting that adoption is hindered by financial, institutional, and technical constraints. The study recommends the introduction of strong policy frameworks, financial incentives, and capacity-building initiatives to enhance the effective adoption of green building assessment systems in South Africa. By identifying key indicators and barriers, this research contributes valuable insights for policymakers and industry practitioners aiming to enhance sustainable construction practices in South Africa.

Keywords

Barriers, Green Building Assessment System, Indicators, South Africa, Sustainability.

1. Introduction

The construction industry's role in global economic development cannot be over-emphasised, as it remains one of the most resource-intensive and environmentally impactful sectors worldwide. Globally, buildings are responsible for approximately 36% of energy use and 39% of carbon dioxide emissions related to energy, making the sector a critical focus for sustainability interventions (IEA, 2022). To address these environmental impacts, the global construction industry has embraced sustainable construction practices, one of which includes the adoption of Green Building Assessment Systems (GBAS). These systems are designed to evaluate, rate, and encourage the implementation of sustainable practices across the life cycle of buildings.

Green building assessment systems provide standardized metrics and performance indicators that guide construction stakeholders in designing environmentally responsible and resource-efficient buildings (Kibert, 2016;

Zuo & Zhao, 2014). Common GBAS include the Leadership in Energy and Environmental Design (LEED) developed in the United States, Building Research Establishment Environmental Assessment Method (BREEAM) in the United Kingdom, and Green Star in South Africa (Zuo & Zhao, 2014). These frameworks typically assess sustainability through various indicators such as energy efficiency, water conservation, indoor environmental quality, site selection, material use, and innovation. Through these indicators, GBAS aims to promote environmentally conscious decision-making and drive the construction sector toward sustainable development goals (Dwaikat & Ali, 2016).

However, the concept of green buildings in South Africa has gained traction in recent years, largely due to growing environmental awareness, regulatory pressures, and support from industry bodies such as the Green Building Council South Africa (GBCSA) (Windapo, 2014). Introduced in 2008, the Green Star SA rating tool was adapted from the Australian Green Star system and contextualised to South African climatic and socio-economic conditions (GBCSA, 2023). Despite the availability of such frameworks, the implementation of GBAS remains limited in scope and scale, especially outside of high-profile commercial developments in major urban centers (Mompati et al., 2024). The fragmented adoption points to a broader issue: the need to clearly define the key performance indicators relevant to South Africa's unique development challenges and to identify the barriers hindering the uptake of green building assessment systems.

Understanding which indicators are most relevant in the South African context is essential to improving the effectiveness and applicability of GBAS. South Africa faces specific environmental and socio-economic conditions including energy insecurity, water scarcity, housing deficits, and socio-economic inequality (Masia et al., 2020; Mompati et al., 2024) which necessitate a tailored approach to sustainability assessment. For instance, while energy efficiency and carbon emissions reduction are global concerns, water conservation and socio-economic inclusivity may be more pressing issues in certain regions of South Africa (Masia et al., 2020; Shackleton et al., 2018). Therefore, identifying the most context-appropriate indicators is vital for ensuring that green building assessment tools are meaningful and impactful at the local level.

In addition to contextual challenges in defining sustainability indicators, there are significant barriers to the effective implementation of green building assessment systems in South Africa. These barriers range from economic constraints such as the high cost of certification and limited access to green financing to institutional and technical issues, including inadequate regulatory frameworks, limited awareness among stakeholders, and a shortage of skilled green building professionals (Aigbavboa et al., 2017; Chan et al., 2018). Resistance to change, fragmented policy implementation, and the perceived complexity of certification processes also pose challenges to widespread adoption (Windapo, 2014). Furthermore, smaller firms and developers operating in informal or low-income housing sectors often lack the capacity or incentive to engage with these formalized assessment tools (Mompati et al., 2024).

Given the increasing urgency of climate change, urbanization, and sustainability in the construction industry, it is imperative to understand both the enabling factors and barriers to the adoption of green building assessment systems. Without addressing these issues, South Africa risks falling behind on its national and international environmental commitments, including the National Development Plan 2030, the Paris Agreement, and the Sustainable Development Goals (SDGs), particularly Goal 11 (sustainable cities and communities) and Goal 13 (climate action) (Republic of South Africa, 2012; United Nations, 2015).

This study, therefore, aims to contribute to the growing body of knowledge on sustainable construction by focusing on two primary objectives: (a) to explore the key indicators for green building assessment systems in South Africa, and (b) to assess the barriers to their implementation. Through a combination of literature review and empirical investigation, this research seeks to provide insights that can inform policy interventions, guide construction practices, and support the localization and refinement of GBAS. Ultimately, the study aspires to promote more sustainable construction practices that are both environmentally sound and socially inclusive, aligning with South Africa's developmental priorities and environmental commitments.

2. Methodology

The study investigates the key indicators used in green building assessment systems, and the barriers affecting its implementation in South Africa. The study was conducted in Gauteng province, South Africa, which was purposively selected due to its high concentration of ongoing construction projects and professionals engaged in sustainable building practices. A quantitative research approach was adopted, with data collected through a structured

questionnaire survey distributed to construction professionals, including quantity surveyors, architects, engineers, and project managers. A purposive sampling strategy was employed to ensure that only respondents with relevant expertise in green building practices participated in the study. In total, 100 questionnaires were distributed electronically via Google Forms, and 60 valid responses were retrieved, representing a 60% response rate. Although the geographical concentration of the study limits the generalizability of the findings to other provinces, Gauteng's prominence as the hub of construction provides meaningful insights. Future research could extend to other provinces such as the Western Cape and KwaZulu-Natal to enhance the applicability of the findings across South Africa. The questionnaire was designed in three sections. Section A collected demographic and professional information such as respondents' roles, academic qualifications, and years of experience. Section B measured the key indicators of green building assessment systems, while Section C examined the barriers to their implementation. Sections B and C were based on a 5-point Likert scale ranging from 1 (Strongly Disagree) to 5 (Strongly Agree), which enabled the ranking of responses and facilitated statistical analysis. Data obtained from Google Forms were exported into Microsoft Excel and analyzed using SPSS version 30.0. The analysis involved descriptive statistics such as frequency, percentage, mean item score, and standard deviation, as well as a one-sample t-test to determine the statistical significance of the identified indicators and barriers. To assess the reliability of the instrument, Cronbach's alpha was calculated for the Likert-scale items, producing a coefficient of 0.924. According to Bujang et al. (2024) Cronbach's alpha coefficient ranges from 0 to 1, with values nearer to 1.00 considered acceptable. This high value confirms strong internal consistency of the measurement items, indicating that the questionnaire consistently captured the intended constructs.

3. Results

3.1 Background information of respondents

According to the respondents' background information presented in Table 1, 46.67% hold a BSc degree, 23.33% an Honours degree, 16.67% a post-matric certificate or diploma, 3.33% an MSc degree, and 10% a PhD. In terms of professional roles, the largest group comprised Construction Managers (35%), followed by Quantity Surveyors (33.33%), Property Managers (11.67%), Construction Project Managers (10%), and Architects (5%). Regarding experience in the adoption of green building assessment systems, 51.67% reported 0–5 years, 28.33% reported 5–10 years, 16.67% reported 10–15 years, and only 3.33% had more than 15 years of experience. These findings suggest that the respondents collectively possess substantial professional expertise and strong academic qualifications, positioning them to provide informed and relevant insights that contribute meaningfully to the objectives of this study.

Table 1: Background information of respondents

Variables	Frequency	Percent
What is your highest educational qualification?		
Post-Matric certificate or Diploma	10	16.67
BSc Degree	28	46.67
Honours' Degree	14	23.33
MSc Degree	2	3.33
PhD	6	10.0
Total	60	100.0
What is your profession?		
Quantity Surveyor	20	33.33
Engineer	3	5.0
Property Manager	7	11.67
Construction Project Manager	6	10.0
Construction Manager	21	35.0
Architect	3	5.0
Total	60	100.0
What is your year of experience?		

0-5years	31	51.67
5-10years	17	28.33
10-15years	10	16.67
More than 15years	2	3.33
Total	60	100.0

3.2 Key Indicators for Green Building Assessment Systems in South Africa

Following a comprehensive review of existing literature, this study identified a set of indicators for green building assessment systems. These identified indicators were then presented to the study's target respondents for evaluation based on their perceived level of agreement. Respondents rated each indicator using a 5-point Likert scale, ranging from "strongly disagree" to "strongly agree." To statistically assess the significance of these indicators, a one-sample t-test was employed. The study formulated a null hypothesis stating that an indicator is insignificant if its mean score is less than or equal to the test value (H_0: $\mu \leq \mu_0$), and an alternative hypothesis that an indicator is significant if its mean score is greater than the test value (H_a: $\mu > \mu_0$). For the one-sample t-test, a test value of 3.5 was selected as the benchmark. This threshold lies between "Neutral" (3) and "Agree" (4) on the 5-point Likert scale and is commonly adopted in construction management research to assess whether the mean responses significantly indicate agreement rather than neutrality (Ikuabe et al. 2024; Chan et al. 2017). Using 3.5 as the test value therefore enhances the analysis by ensuring that only factors rated above neutrality and leaning towards agreement are considered significant. As shown in Table 2, the results of the one-sample t-test revealed that all the identified indicators have p-values (Sig.2-tailed) less than 0.05 at a 95% confidence level, thereby indicating that each indicator is statistically significant and perceived by respondents as key indicators to green building assessment in South African construction industry.

Table 2 shows the result of the ranked green building assessment indicators in South Africa. The results show that the most significant green building assessment indicator are "energy efficiency" (MIS=4.27, StD=0.918, sig.=0.000), "carbon emission reduction" (MIS=4.27, StD=1.023, sig.=0.000), "water efficiency" (MIS=4.20, StD=1.086, sig.=0.000), "indoor environmental quality" (MIS=4.18, StD=0.983, sig.=0.000), and "resource utilisation" (MIS=4.18, StD=1.049, sig.=0.000).

Table 2. Summary of t-test showing key indicators to green building assessment

Test Value = 3.5
p-values less than 0.05 @ 95% confidence level

Indicators to green building assessment	Mean	Std. Deviation	p-value (Sig. 2-tailed)	Rank
Energy efficiency	4.27	.918	.000	1
Carbon emission reduction	4.27	1.023	.000	2
Water efficiency	4.20	1.086	.000	3
Indoor Environmental Quality	4.18	.983	.000	4
Resource utilisation	4.18	1.049	.000	5
Waste and pollution	4.17	.960	.000	6
Sustainable site development	4.15	.954	.000	7
Management	4.13	1.049	.000	8
Safety	4.12	.976	.000	9
Innovative designs	4.10	1.037	.000	10
Durability	4.08	.996	.000	11

3.3 The Barriers to Green Building Assessment Systems in South Africa

Following a thorough review of existing literature, the study identified a range of barriers impeding the implementation of green building assessment systems. These identified barriers were then subjected to empirical validation by soliciting the perceptions of construction professionals within the South African context. Respondents evaluated each barrier using a 5-point Likert scale, ranging from "strongly disagree" to "strongly agree." To analyse the responses, a one-sample t-test was employed to determine the statistical significance of each barrier. The null hypothesis (H_0: $\mu \leq \mu_0$) posited that a barrier is not statistically significant if its mean score is less than or equal to the hypothesised population mean, while the alternative hypothesis (H_a: $\mu > \mu_0$) proposed that a barrier is significant if its mean score exceeds the population mean. A test value (μ_0) of 3.50 was adopted, reflecting a threshold between neutrality and agreement. Thus, barriers with a mean score above 3.50 were interpreted as statistically significant, while those at or below this threshold were deemed insignificant. The results, presented in Table 3, demonstrate that all the identified barriers except two, are statistically significant, as evidenced by p-values (Sig.2-tailed) less than 0.05 at a 95% confidence level.

Table 3 shows the result of the ranked green building assessment systems barriers in South Africa. The results show that the most significant green building assessment barriers are “high investment cost” (MIS=4.17, StD=1.060, sig.=0.000), “risks and uncertainties” (MIS=4.07, StD=1.023, sig.=0.000), “failure to commit to environmental protection” (MIS=4.05, StD=1.080, sig.=0.000), “lack of implementation of green building policies and regulations acts” (MIS=4.05, StD=1.126, sig.=0.000), and “lack of government support” (MIS=4.03, StD=1.248, sig.=0.000).

Table 3. Summary of t-test showing the barriers to green building assessment systems

Test Value = 3.5
p-values less than 0.05 @ 95% confidence level

Barriers To Green Building Assessment Systems	Mean	Std. Deviation	p-value (Sig. (2-tailed)	Rank
Higher investment costs	4.17	1.060	.000	1
Risks and uncertainties	4.07	1.023	.000	2
Failure to commit to environmental protection	4.05	1.080	.000	3
Lack of implementation of green building policies and regulations acts	4.05	1.126	.000	4
Lack of government support	4.03	1.248	.002	5
Lack of awareness	3.97	1.164	.003	6
Higher costs	3.95	1.199	.005	7
Lack of incentives	3.93	1.056	.002	8
Inefficiency in adopting sustainable construction	3.93	1.103	.003	9
Lack of building codes and regulations	3.93	1.133	.004	10
Lack of technological advancements	3.92	1.211	.010	11
Inadequate understanding	3.83	1.076	.020	12
Lack of demand	3.82	1.157	.038	13
Fear of liability and litigation	3.78	1.106	.052	14
Lack of knowledge	3.77	1.212	.094	15

4. Discussion

The findings from this study offer empirical insights into the critical indicators and prevailing barriers influencing the implementation of green building assessment systems (GBAS) in South Africa. The one-sample t-test results

confirm that all assessed indicators were statistically significant, reinforcing their relevance within the South African green construction context.

Energy efficiency and carbon emission reduction were ranked highest, underscoring the sector's increasing awareness of environmental sustainability. These findings are consistent with Ghaffarianhoseini et al. (2017) and Darko and Chan (2018), who identified energy performance and carbon footprint reduction as central pillars in most global GBAS frameworks such as LEED and BREEAM. Similarly, water efficiency, indoor environmental quality, and resource utilization followed closely in importance, reflecting growing concerns over water scarcity and material sustainability in the region (Ahiabu et al., 2022; Oladokun & Aigbavboa, 2018). On the other hand, the ranking of innovative designs, safety, and durability towards the bottom, despite their significance, suggests that while innovation and resilience are recognized, they may still be underemphasized in assessment practice. This aligns with findings by Olanrewaju and Abdul-Aziz (2015), who argue that innovation in green construction is often limited by cost and compliance concerns in developing economies.

Furthermore, the study revealed the barriers to the implementation of GBAS. The most significant barriers was the higher investment costs, aligning with literature that frequently identifies initial capital expenditure as a primary constraint to sustainable building adoption (Aigbavboa et al., 2017; Häkkinen & Belloni, 2011). Closely related barriers included risks and uncertainties, lack of implementation of green building policies, and inadequate government support, which reflect systemic issues affecting policy enforcement and institutional readiness. These results echo those of Darko and Chan (2018), who emphasized the lack of enabling environments in many African countries as a critical impediment to green construction. Interestingly, barriers such as fear of litigation and lack of knowledge were statistically insignificant. While these issues are often highlighted in literature (Chan et al., 2018; Kibert, 2016), their lower mean ratings suggest that South African construction professionals may now possess a relatively higher awareness and confidence in the legal and educational domains, possibly due to growing advocacy and professional development around sustainability.

Overall, the results show a convergence with global green building principles, while highlighting context-specific barriers rooted in economic and institutional limitations. Therefore, to enhance the uptake of GBAS in South Africa, policy makers and industry stakeholders must address systemic financial constraints and institutional inertia, while reinforcing existing awareness and performance-based incentives.

5. Conclusion and Recommendations

This study examined the key indicators and barriers associated with the implementation of green building assessment systems in South Africa. The findings reveal that energy efficiency, carbon emission reduction, and water efficiency are the most significant indicators recognised by stakeholders. These indicators reflect the growing emphasis on sustainable design and resource optimisation within the South African construction industry. Despite the importance attached to these indicators, the study also identified several persistent barriers. High investment costs, risks and uncertainties, lack of policy enforcement, and inadequate government support were found to be the most critical barriers hindering the effective implementation of green building assessment systems. These obstacles suggest that while awareness of sustainable practices is increasing, practical adoption is still constrained by institutional, financial, and technical limitations. Overall, the results highlight a need for targeted interventions that promote green construction through stronger policy frameworks, enhanced stakeholder collaboration, and the provision of economic and technical support. Addressing these challenges will be essential in advancing sustainable building practices and ensuring the successful integration of green building assessment systems in the country's construction sector.

Based on the study's findings, it is recommended that the South African government strengthen policy frameworks and enforcement mechanisms to ensure the consistent adoption of Green Building Assessment Systems (GBAS) across the construction sector. Financial incentives such as tax rebates, grants, and low-interest loans should be introduced to mitigate high initial investment costs, which are a major barrier to implementation. Additionally, capacity building through targeted training and professional development programs is essential to address technical uncertainties and enhance industry competence in applying green building standards. Collaboration among government bodies, industry professionals, academic institutions, and private stakeholders should also be encouraged to promote knowledge sharing and innovation. These measures, collectively, would support a more widespread and effective implementation of GBAS, advancing sustainability in the South African construction industry. However, future studies could address the limitations of this study by expanding the sample to include

multiple provinces, adopting mixed methods approaches, and incorporating longitudinal designs to track changes over time.

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