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Strategic Pathways to Sustainable Development: A Comprehensive Review of the Benefits and Barriers of Green Buildings

Fathin Shahiera Nooradzhar*, Mat Naim Abdullah @ Mohd Asmoni

Department of Real Estate, Faculty of Built Environment and Surveying, Universiti Teknologi Malaysia, Skudai, Johor, Malaysia

*Corresponding author's email: fshahiera@gmail.com

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Abstract

As environmental concerns grow globally, green building practices have become essential in promoting sustainable development. This paper provides a comprehensive review aimed at evaluating the multifaceted benefits, barriers, and strategic pathways related to the implementation of green buildings. The study employs a systematic literature review, analysing 90 significant studies from databases such as Scopus, Google Scholar, and Web of Science, to assess the economic, environmental, and social impacts of green building practices. The results highlight that green buildings offer substantial benefits, including reduced energy consumption, improved indoor air quality, enhanced occupant health and productivity, and long-term cost savings. Despite these advantages, the widespread adoption of green building practices faces considerable challenges, notably high initial construction costs, regulatory obstacles, and limited awareness among stakeholders. Furthermore, the study identifies significant gaps in the existing literature concerning the regional and contextual variations in the effectiveness of green building strategies. The implications of this research are crucial for policymakers, developers, and industry professionals who are working towards sustainable urban development. The findings suggest that overcoming the identified barriers requires coordinated efforts, including the implementation of supportive policies, financial incentives, and extensive public education campaigns. By addressing these challenges, green buildings can play a pivotal role in achieving global sustainability goals and fostering resilient, eco-friendly urban environments.

Keywords: Sustainability development, green building, benefits, barriers, environmental impact

1.0 INTRODUCTION

With sustainable development and the predominance of green building projects, a significant gap in existing literature can be defined concerning ways of integrating green building practices in various socio-economic contexts. Unlike developed countries, where the advantages and peculiarities of green buildings have been extensively described, and the barriers to green building projects have been defined, developing states are underrepresented in the existing research (Amri et al., 2023; Sabbagh et al., 2019). Thus, effective ways of overcoming existing challenges to implement sustainable building projects are not defined. This study aims to fill this gap by systematically reviewing the global challenges and opportunities associated with green building practices, providing insights into how these practices can be more effectively implemented to support sustainable development (Rahim et al., 2023).

Blewitt (2008) argues that sustainable development is an idea where the future should be better, and healthier than the current state and situation. Furthermore, he emphasises that this idea is not new, but the way it is understood, reflected, and implemented must adapt to the current context. Sustainable development is a process that requires us to view our lives as part of a larger entity. It necessitates a holistic approach to seeing the world and human life because individuals may have different perceptions, values, philosophies, and goals. Therefore, a high level of understanding is crucial. As issues related to sustainability continue to evolve, this concept has become more complex and challenging to define. Nowadays, the concept and terminology have given rise to a diversity of meanings, depending on the field involved. Some writers argue that the concept of sustainability is vague and allows for easy misinterpretation (Mebratu, 1998; Missimer et al., 2017a, 2017b; Robinson, 2004). According to Donaires et al. (2019), discussions about sustainable development are related to three dimensions, which involve the economy, the environment, and culture. The concept of the "triple bottom line" introduces a vision of sustainability that connects social, environmental, and economic dimensions. Sustainable development is a concept that combines various societal aspects, seeking to protect the environment and maintain natural resources to achieve economic prosperity and equity for both the present and future generations.

Sustainable development acknowledges the interconnectedness between humans, the Earth, and its resources. This concept is intricately linked to both national and international development policies, thus becoming a fundamental component in government publications, international organisations, and corporate entities (Mebratu, 1998; Omar, 2019). Some systems thinkers believe that efforts to

achieve global sustainability are ineffective. Moreover, the process of translating the concept of sustainability into practice is challenging, and therefore, comprehensive guidance is needed to frame strategies and necessary steps to realise this concept of sustainability (Taisch et al., 2015).

Schwaninger (2015) once raised the question of how humans can organise themselves to develop sustainably. Therefore, according to Ratiu and Anderson (2014), to enable sustainable development worldwide, several proactive steps need to be considered, including:

- Government-formulated policies
- Well-designed strategies by organisations
- Development of infrastructure
- Creation of products and services
- Reallocation of resources

These steps are crucial for fostering sustainable development on a global scale. All these adjustments are made based on individual understandings of sustainable development concerning their respective activities. However, a lack of shared understanding can lead to ambiguity, misunderstandings, and even conflicts, even though everyone is striving towards the same goal. Sustainability or green building, as the application of sustainable principles to the construction sector, can be an effective strategy to address adverse environmental impacts and serve as a foundation for creating healthier and more ecological cities (Balapan & de Oliveira, 2017).

■2.0 STUDY GAP AND RATIONALE

While green building practices have gained considerable attention in recent years as a key component of sustainable development, existing literature often focuses on isolated aspects, such as environmental benefits or economic feasibility, without providing a holistic analysis that integrates these dimensions. Moreover, there is a lack of comprehensive studies that address the intersection of green building implementation barriers, particularly in varying geographic and economic contexts and their impact on the broader goals of sustainable development.

The current body of research frequently overlooks the challenges faced by developing countries where regulatory frameworks, financial constraints, and public awareness significantly differ from those in more developed regions. This gap in understanding the context-specific barriers and facilitators of green building adoption limits the effectiveness of global sustainability strategies.

This study addresses these critical gaps by offering an integrated review that not only examines the benefits of green buildings but also systematically analyses the barriers to their adoption across different regions. By doing so, it provides valuable insights into the strategic measures necessary to overcome these challenges, thus contributing to the global discourse on sustainable urban development. The findings are particularly significant for policymakers and practitioners seeking to promote green building practices in diverse contexts, thereby advancing the global sustainability agenda.

■3.0 METHODOLOGY

This study was conducted as a systematic literature review, following the data collection guidelines outlined by Finney and Corbett (2007). The subsequent section provides a detailed overview of the procedures used in this systematic literature review which is, Carley (1992) who proposed eight category coding steps for the data collection process, specifically applied to the outsourcing of building operation and maintenance:

3.1 Select the Level of Analysis

In this step, a decision was made on whether to search for individual words, sets of words, or phrases. According to Berg (2004), the initial step in content analysis involves determining the level of analysis and identifying the units to be counted. For this study, the unit of analysis was entire journal articles. The data collection process involved an extensive search across various journals, including Built Environment Project and Asset Management, International Journal of Construction Management, International Journal of Built Environment and Sustainability, Journal of Engineering, Design and Technology, Environmental Management and Sustainable Development, Journal of Building Engineering, Journal of Applied Engineering Science, Social and Behavioral Sciences, World Journal of Science, Technology and Sustainable Development, and International Journal of Energy Production and Management.

In addition to these journals, the search extended to databases such as ScienceDirect Journal, Web of Science, Emerald, Academic Search Premier, IEEEXplore Digital Library and JSTOR. These databases collectively host hundreds of journals across various fields. The selection of articles from the search results was based on the search terms used, for example, Green Building “AND” Benefits, Green Building “AND” Barrier, Green Building “AND” Sustainability, Sustainability “AND” Challenges, Benefits and Barriers “AND” Green Building and Benefits and Barriers “AND” Sustainability.

The selected keywords for this search were drawn from the keywords provided by authors in relevant articles identified during the initial literature review. The primary focus was on green building development and sustainability. The search was limited to peer-reviewed or scholarly journals. The decision to include an article in the review was based on the researcher's assessment of the abstract and title.

3.2 Determine the Coding Steps

In this phase of the coding process, it is essential to decide how many steps to code for. This involves choosing whether to code based on a predefined theoretical framework or to take a more interactive, iterative coding approach. Berg (2004) notes that theoretical categories refer to concepts that emerge during data analysis.

3.3 Decide Whether to Code for Presence or Frequency of Concepts

At this stage of the coding process, the focus is on coding for the frequency of concepts, which helps in gaining a deeper understanding of the relative significance of the various factors.

3.4 Determine How to Distinguish Between Concepts

This stage involves deciding whether to code concepts exactly as they appear or to code them in a modified or grouped form. This phase is commonly referred to as the term generalisation phase. In this study, words with similar meanings were grouped under the same construct.

3.5 Establish Rules for Text Coding

It is essential to create a set of translation guidelines that can be applied consistently to ensure coherence and internal validity. For this study, the following translation rules were developed and implemented. During the initial review of all articles, the primary focus was on identifying references related to "benefits and barriers of green buildings." These identified concepts were recorded in a bibliographic program without being assigned to specific categories at this stage. In the second round of article review, the goal was to identify similarities among concepts and group them accordingly. Each category and concept was carefully examined to determine whether merging or subdividing was necessary and whether additional categories were needed. Once all categories were finalised, the concepts were further analysed to determine the appropriate construct terms, which could either be adapted from existing coded terms or introduced as entirely new ones.

3.6 Decide How to Handle ‘Irrelevant’ Information

In this step of the coding process, the task is to determine how to manage any 'irrelevant' information found within the text. For this research, since the literature review focused on gathering all ideas related to the benefits and barriers of green buildings, the content analysis encompassed the entire document, coding only the text that indicated relevant information on the advantages and disadvantages criteria. Consequently, there were no issues regarding the handling of irrelevant coded information.

3.7 Code the Text

At this stage, the manual coding process was carried out, strictly following all the translation rules established in Step 3.5.

3.8 Analyse the Results

In this phase of the coding method, one must choose whether to code based on a predefined theoretical framework or to use a more interactive coding approach. Berg (2004) describes theoretical categories as concepts that emerge during data analysis. As previously mentioned, the benefits and barriers of green building development and their categories are included in the emerging classes in this study, as they are present in the existing literature (Berg, 2004).

3.9 Data Extraction

The search process yielded 150 studies based on the specified search terms. Out of these, 60 studies were excluded as they did not meet the inclusion criteria after reviewing their abstracts. Data from the remaining studies were then extracted and organised into two categories, one focused on examining the benefits, and the other on evaluating the barriers of green buildings.

■4.0 RESULTS AND DISCUSSION

4.1 Green Building

Green building, also known as sustainable or high-performance building, is a concept aimed at reducing or eliminating harm to the environment throughout a building's entire lifespan while also making positive contributions to climate and nature (Zhang et al., 2019). This involves reducing environmental damage, conserving resources, using them efficiently, and fulfilling social responsibility obligations, all while ensuring positive and healthy effects throughout the building's life (Zainol et al., 2023). Green buildings are designed, constructed, and operated with a focus on improving energy, water, and material efficiency while minimising negative impacts on the environment and human health (Mukattash & Hyarat, 2023).

Furthermore, green building concepts extend beyond the buildings themselves to include factors such as site planning, community planning, and land use concerns (Sadanand et al., 2021). These sustainable buildings aim to reduce the negative impacts of construction by conserving energy and water, promoting healthy indoor spaces, and minimising harmful effects on the environment from construction activities (Raouf & Al-Ghamdi, 2020). Additionally, green buildings play a crucial role in the construction sector, driving an overhaul of the entire industry process (Orsi et al., 2020). Green buildings are eco-friendly structures meant to minimise their impact on nature by using resources efficiently and sustainably throughout their lifespan. They prioritise saving energy and water, ensuring healthy indoor spaces, and promoting sustainable practices, thereby contributing to a more environmentally friendly and sustainable construction industry.

These green buildings can also be defined as construction practices that prioritise holistic quality (including economic, social, and environmental performance). The utilisation of natural resources and appropriate building management contribute to conserving limited resources, reducing energy consumption, and enhancing environmental quality. Green building projects identify five main objectives which are :

- Resource efficiency, such as resource conservation;
- Energy efficiency, including greenhouse gas emissions reduction;
- Pollution prevention, which involves indoor air quality and noise reduction that justifies sustainable buildings;
- Environmental harmony, including environmental assessments; and Integrated and systematic approaches, which encompass environmental management systems

The growing demand for sustainable development has highlighted the importance of implementing green building practices, particularly in rapidly urbanising regions of the developing world. In Southeast Asia, particularly Vietnam, the need for green building practices is critical due to rapid urbanisation and environmental challenges. The government has already introduced policies to promote sustainability, such as transitioning from traditional agriculture to integrated farming, which could be expanded to include green building certifications aligned with international standards. Public-private partnerships can also support investment in green infrastructure, making sustainable building practices more economically viable (Binh et al., 2023; Lin & Wang, 2019).

In Indonesia, decentralising natural resource management policies presents an opportunity to promote green building codes at the local level, supported by financial tools like green bonds or low-interest loans. Public awareness campaigns would further boost demand for green buildings (Mihayo & Swai, 2019; Parluhutan et al., 2022;). In West Africa, particularly Ghana, the high costs and limited stakeholder awareness hinder the adoption of green building technologies. Governments can address this by highlighting long-term savings and environmental benefits, establishing certification systems, and collaborating with international organisations for technical and financial support (Darko et al., 2018; Zhang et al., 2019). Overall, policy interventions must focus on capacity building, financial incentives, and public engagement to facilitate sustainable building practices across developing regions.

4.2 The Benefits of Green Buildings

Green buildings offer various benefits across environmental, economic, and social aspects, which have been extensively studied and documented. They play a crucial role in transitioning the construction industry towards sustainability and energy efficiency, aligning with national strategies for sustainable development (Liu et al., 2022). The energy-saving advantages of green buildings are significant, with factors such as lighting and ventilation performance playing critical roles in enhancing energy efficiency (Wang & Hu, 2022).

According to Hong (2016), green buildings can improve the productivity and performance of occupants, enhancing their competitiveness. Additionally, other benefits of green buildings, as noted by Hong (2016), include cost savings in the life cycle of the building, improved occupant health, and the potential for increased average rent and property value. These sentiments are further supported by Ohueri (2020), highlighting the environmental, economic, and social benefits of green buildings.

Among the environmental benefits are improvements in water and air quality and a reduction in waste. From an economic standpoint, green buildings can lead to cost savings in terms of operations and maintenance. On the social front, they can enhance productivity and promote better health among occupants of green buildings. Green buildings provide more than just environmental and economic benefits; they also promote social well-being, community involvement, and fairness. By focusing on occupant health, community engagement, and inclusiveness, green buildings help create a built environment that is both sustainable and socially responsible.

Furthermore, green buildings offer not only environmental and social advantages but also significant economic benefits. Studies in regions like Malaysia have highlighted the positive economic impacts of green buildings (Dwaikat & Ali, 2018). Moreover, the economic sustainability of green buildings has been compared to that of non-green buildings, showing the economic advantages of green building practices (Weerasinghe & Ramachandra, 2018). Green buildings provide significant economic benefits in addition to their environmental and social advantages, making them not just environmentally sustainable but also financially rewarding.

Green buildings generally command higher market values compared to traditional buildings due to their perceived benefits, such as reduced carbon emissions and energy savings, which make them more attractive to buyers and investors (Liu et al., 2022; Zhao et al., 2023). In markets where sustainability is becoming a key priority, properties with green certifications often achieve premium prices, contributing to the overall economic growth of the area (Liu et al., 2022). Furthermore, the construction and maintenance of green buildings stimulate job creation across various sectors, including construction, manufacturing, and renewable energy industries (Alkali, 2024). As the demand for sustainable technologies and practices increases, so does the need for skilled labour, helping to reduce unemployment and bolster economic resilience in local communities (Alkali, 2024). Additionally, green building projects often consider the surrounding community by incorporating features like green spaces and enhanced public amenities, which can improve social cohesion and quality of life (Joshi et al., 2020).

Features such as green roofs and community gardens not only offer aesthetic benefits but also support biodiversity and encourage community participation (Joshi et al., 2020). Lastly, promoting green buildings raises public awareness about sustainability, with educational initiatives empowering communities to adopt eco-friendly practices, fostering a culture of environmental stewardship and increasing support for sustainability policies (Ibrahim & Raji, 2018). Table 1 summarises the findings on the benefits of green buildings.

Table 1 Summary of green building benefits

Category	Benefits	References
Social	Improved Health and Productivity	Samosir et al. (2020), Singh et al. (2019), Rahim et al. (2023), Kim et al. (2020), Reddy (2016), Opoko et al. (2022), Ayuthia et al. (2020), Sun et al. (2019), Doan and Qin (2023), Ragheb et al. (2016)
	Improved Indoor Air Quality	Moradi and Kähkönen (2022), Opoko et al. (2022), Feitosa and Wilkinson (2018)
	Enhanced Comfort and Environment	Rahim et al. (2023), Kim et al. (2020), Moradi and Kähkönen (2022), Opoko et al. (2022), Dimitrijevic et al. (2018), Forsberg and Souza (2021)
	Fostering Sustainability	Ayuthia et al. (2020)
Economic	Savings and Reduced Costs	Rahim et al. (2023), Reddy (2016), Samosir et al. (2020), Sun et al. (2019), Ravasio et al. (2020), Kieu and Schäfer (2020), Wang and Hu (2022), Wang and Wei (2020)
	Positive Financial Returns	Verma et al. (2021), Kieu and Schäfer (2020), Akreim and Süzer (2018)
	Resource Efficiency	Doan and Qin (2023), Opoko et al. (2022), Hsieh et al. (2020), Ravasio et al. (2020)
Environmental	Carbon Emission Reduction	Liang et al. (2021), Reddy (2016), Roh et al. (2018), Larasati et al. (2020), Liao and Li (2021), Remizov et al. (2021), Moghayedi et al. (2022)
	Environmental Protection and Resource Conservation	Ayuthia et al. (2020), Opoko et al. (2022), Wang and Hu (2022)

4.2.1 Improved Health and Productivity

The benefits of green buildings in improving health and productivity are well-documented across various studies. Samosir et al. (2020) highlight that green buildings contribute significantly to improved health and productivity. Singh et al. (2019) support this by noting that such environments enhance both occupant health and productivity. Similarly, Rahim et al. (2023) emphasise that green buildings promote occupant well-being through improved indoor environmental quality, enhanced comfort, and increased productivity. Kim et al. (2020) also underscore the positive impact of green buildings, citing enhanced productivity and improved health of occupants as key outcomes. Reddy (2016) further reinforces this by noting the improvement in user productivity, health, and comfort in green buildings. Opoko et al. (2022) echo these findings, stating that green buildings enhance the health and productivity of occupants. Ayuthia et al. (2020) concur, stressing the importance of maximising both health and productivity in these sustainable environments. Sun et al. (2019) similarly emphasise the role of green buildings in maximising occupant health and productivity. Doan and Qin (2023) expand on this by highlighting how green buildings create a healthy environment, thereby improving overall societal well-being. Additionally, Ragheb et al. (2016) affirm the positive impact of green buildings on occupant health. Collectively, these studies underline the significant role of green buildings in fostering environments that enhance both health and productivity.

4.2.2 Improved Indoor Air Quality

Moradi and Kähkönen (2022) point out that green buildings significantly improve indoor air quality, contributing to a healthier living and working environment. Similarly, Opoko et al. (2022) emphasise the role of green buildings in improving indoor air quality, which is essential for occupant well-being. Additionally, Feitosa and Wilkinson (2018) extend this benefit by noting that green buildings not only enhance air quality but also reduce noise levels, further contributing to a more comfortable and healthier indoor environment. These studies collectively underscore the importance of green buildings in providing superior indoor air quality, which is crucial for maintaining occupant health and comfort.

4.2.3 Enhanced Comfort and Environment

Green buildings significantly enhance comfort and the overall environment for occupants. Rahim et al. (2023) highlight that green buildings are designed to provide enhanced comfort, making indoor spaces more pleasant and conducive to well-being. Kim et al. (2020) further note that these buildings create a more favourable indoor environment, which is essential for occupant satisfaction. Moradi and Kähkönen (2022) add that green buildings improve comfort by increasing natural lighting, enhancing thermal comfort, and providing better outdoor air quality, while also reducing heat stress for pedestrians. Opoko et al. (2022) similarly emphasise the benefits of natural

lighting and thermal comfort provided by green buildings. Dimitrijevic et al. (2018) point out that green buildings foster a sense of community by integrating green spaces, communal areas, and amenities that encourage social interactions among residents. Forsberg and Souza (2021) also underscore the importance of green buildings in enhancing accessibility and inclusivity, creating equitable and accommodating environments for individuals of diverse backgrounds and abilities. Collectively, these studies demonstrate that green buildings not only improve physical comfort but also contribute to a more inclusive and socially engaging environment.

4.2.4 Fostering Sustainability

Green buildings play a crucial role in fostering sustainability, as highlighted by Ayuthia et al. (2020). The study emphasises that green buildings are instrumental in cultivating a culture of sustainability within communities and organisations. By adopting sustainable practices in the design, construction, and operation of buildings, green buildings encourage individuals and businesses to prioritise environmental stewardship, resource efficiency, and long-term ecological health.

4.2.5 Savings and Reduced Costs

Green buildings offer significant savings and reduced costs, as demonstrated by various studies. Rahim et al. (2023) note that green buildings lead to reduced resource usage, decreased maintenance expenses, and energy savings that greatly surpass the initial investment. Similarly, Reddy (2016) highlights that green buildings result in substantial savings on operational and maintenance costs, including energy, water, and material resources. Samosir et al. (2020) also emphasise energy savings, reduced resource usage, and decreased maintenance expenses as key benefits of green buildings. Sun et al. (2019) further elaborate on these advantages, noting that green buildings contribute to energy savings, emissions reductions, water conservation, and overall operational and maintenance savings. Ravasio et al. (2020) add that green buildings lower building life-cycle costs, decrease annual energy and water costs, and increase company profitability. Kieu and Schäfer (2020), support these findings by pointing out the savings in operation costs associated with green buildings. Additionally, Wang and Hu (2022) and Wang and Wei (2020) emphasise the broad benefits of green buildings in terms of energy conservation, as well as the conservation of land, water, and material resources. Collectively, these studies underscore the substantial financial benefits of green buildings, which not only reduce costs but also enhance long-term profitability and sustainability.

4.2.6 Positive Financial Returns

Verma et al. (2021) note that investments in green buildings often result in a positive net present value (NPV), with the added potential for enhanced stock market returns due to the sustainability and efficiency of these investments. Similarly, Kieu and Schäfer (2020), emphasise that green building investments tend to yield positive NPV and may lead to higher stock market returns, making them attractive to investors. Akreim and Süzer (2018) further support these findings by pointing out that green buildings often experience shorter payback periods, higher property values, and increased transaction, rental, and occupancy rates. These studies collectively illustrate that green buildings not only provide environmental and social benefits but also offer significant financial advantages, making them a sound investment choice.

4.2.7 Resource Efficiency

Doan and Qin (2023) highlight that green buildings promote the responsible management of resources and enhance energy efficiency, which are key components of sustainable development. Opoko et al. (2022) add that this efficient use of resources not only benefits the environment but also fosters economic growth. Hsieh et al. (2020) point out that resource efficiency in green buildings can lead to a reduced cost of equity capital through Real Estate Investment Trusts (REITs), further emphasising the financial advantages of sustainable practices. Ravasio et al. (2020) also note that efficient resource management in green buildings can increase company profitability, making them not only environmentally responsible but also economically beneficial. These studies collectively underscore the importance of resource efficiency in green buildings, highlighting both their environmental impact and their potential for enhancing economic outcomes.

4.2.8 Carbon Emission Reduction

Liang et al. (2021) and Reddy (2016) both emphasise that green buildings are effective in significantly reducing carbon emissions. Roh et al. (2018) further elaborate on this by highlighting the importance of focusing on life cycle assessment criteria to achieve substantial reductions in carbon emissions. Similarly, Larasati et al. (2020) and Liao and Li (2021) point out the efficiency of green buildings in reducing carbon emissions, with Liao and Li (2021) specifically noting the enhancement in the efficiency of carbon emission reduction. Remizov et al. (2021) expand on this by discussing how green buildings contribute to reducing carbon footprints, decreasing energy consumption, and mitigating environmental pollution. Moghayedi et al. (2022) reinforce these findings by confirming that green buildings can lead to significant reductions in carbon emissions. Collectively, these studies underline the critical impact of green buildings in mitigating climate change through effective carbon emission reduction strategies.

4.2.9 Environmental Protection and Resource Conservation

Ayuthia et al. (2020) emphasise that green buildings minimise negative impacts on the environment, ensuring that development is sustainable and environmentally responsible. Opoko et al. (2022) add that green buildings help reduce environmental degradation and

conserve natural resources, making them vital for long-term environmental sustainability. Wang and Hu (2022) also point out that green buildings improve lighting and ventilation performance, which in turn enhances overall environmental protection. These studies collectively demonstrate that green buildings are instrumental in protecting the environment and conserving resources, making them a key component of sustainable development strategies.

Figure 1 below provides a summary of the key benefits of green buildings along with the number of references supporting each benefit. It highlights "Improved Health and Productivity" and "Savings and Reduced Costs" as the most frequently cited advantages, followed by "Carbon Emission Reduction" and "Enhanced Comfort and Environment." These benefits emphasise the positive impact of green buildings on both environmental sustainability and economic savings.

Figure 1 Green building benefits

4.3 Barrier in Green Building Development

The journey towards widespread adoption of green buildings encounters a multitude of challenges spanning technical, managerial, behavioural, financial, regulatory, and awareness-related aspects (Amri et al., 2023). In countries like Saudi Arabia, barriers such as limited awareness, insufficient government support, unclear policies, and a scarcity of local sustainable materials hinder progress in green construction (Amri et al., 2023). Similarly, in Kosovo, regulatory hurdles impede the uptake of green building materials, underscoring the global scope of this issue (Hoxha & Lecaj, 2022). In Indonesia, the absence of binding legal frameworks for green building construction presents a significant obstacle to achieving sustainable buildings (Putra & Alfieta, 2022).

The development of green buildings is thwarted by a complex web of challenges, from technical and financial hurdles to regulatory and governmental barriers. Overcoming these obstacles demands a comprehensive approach that involves crafting supportive policies, raising awareness, providing financial incentives, fostering research and development, and ensuring the availability of sustainable materials and technologies.

In China, mandatory green policies and regulations exert pressure on developers to prioritise the construction of green buildings (Song, 2023). Meanwhile, policymakers in Indonesia can address barriers to green building implementation by offering incentives and training to owners (Susanto & Sujana, 2023). Effective regulatory planning in China holds the potential to mitigate and adapt to climate change by improving urban microclimates and advocating for green traffic infrastructure (Yin et al., 2021).

Nonetheless, the market entry of green buildings faces hurdles due to the dominance of traditional building practices, highlighting the necessity for innovative strategies (Yang et al., 2022). Post-occupancy evaluations of green buildings reveal that certification alone does not guarantee that all components meet comfort, health, and safety standards (Nugradi, 2022). The proliferation of green technologies in construction is influenced by state innovation policies supporting research, technology transfer, and regulatory updates (Zgalat-Lozynska, 2020).

Furthermore, professionals face challenges concerning capability, design, technology, rising expenses, inadequate financial backing, and knowledge and cultural obstacles in green building projects (Rahim et al., 2023). The multidisciplinary aspect of green system design requires improved coordination, which complicates project management (Mukattash & Hyarat, 2023). Additionally, the absence of established green technology and an underdeveloped market for green materials impede the progress of green buildings (Yousif et al., 2023). Companies' hesitancy to embrace green building practices due to worries about profitability and risk aversion can result in subpar performance regarding project schedules and quality (Azmi et al., 2022).

The social obstacles in green building development are worsened by limited public understanding of the benefits of green buildings, a shortage of trained experts, and the perception of green design features as expensive technologies that might harm project profitability (Elnaklah et al., 2020). Despite the benefits provided by green buildings, worries about high initial expenses and project efficiency remain significant barriers to widespread adoption (Pandithawatta et al., 2019; Khun-anod & Limsawasd, 2019). Challenges related to safety risks, project management effectiveness, and the implementation of green project management practices also affect green building projects (Zhang & Wang, 2023).

Developers find the intricate nature of green building design and the lack of a clearly outlined green building delivery process to be discouraging (Ohueri et al., 2019). Simplifying processes and providing clearer guidelines can aid in increasing the adoption of green building practices. Managers overseeing green building projects encounter distinct challenges compared to conventional construction projects, such as navigating more intricate issues throughout the construction process (Sang et al., 2018).

In many contexts, the lack of awareness about the advantages of green buildings poses a barrier to their widespread adoption. For example, research in Ghana reveals that potential buyers are often unaware of the long-term cost-saving benefits of green buildings, resulting in hesitation to pay higher prices for such properties (Lawluvy et al., 2022). To address these knowledge gaps, public education campaigns and active stakeholder engagement are essential (Ibrahim & Raji, 2018). Furthermore, the success of green building initiatives largely depends on supportive regulatory frameworks. Weak policies or lack of enforcement can significantly limit the effectiveness of green buildings (Addy et al., 2020). To promote green building practices effectively, governments need to establish clear guidelines and standards, ensuring developers comply with sustainable construction practices (Addy et al., 2020). Table 2 tabulates the findings regarding the challenges in implementing green building development.

Table 2 Summary of challenges and barriers for green building development

Category	Barriers	References
Economic	High Initial Costs	Wang and Wei (2020), Jayantha and Kwong (2018), Sabbagh et al. (2019), Wu and Lo (2018), Weerasinghe and Ramachandra (2020), Ali et al. (2022), Samosir et al. (2020)
	Financial Constraints	Wu and Lo (2018), Agyekum et al. (2019), Ha et al. (2023), Ebekozien et al. (2021)
	Market and Transaction Costs	Zhou et al. (2022)
Organisational & Structural	Lack of Skilled Workers	Shen et al. (2018), Sabbagh et al. (2019)
	Lack of Knowledge and Skills	Cao et al. (2022), Aghimien et al. (2018), Ha et al. (2023)
	Lack of Awareness	Darko et al. (2018), Mouzaneh et al. (2022), Aghimien et al. (2018), Assyibekov et al. (2021)
	Design and Planning Challenges	Orsi et al. (2020), Ebekozien et al. (2021), Cao et al. (2022)
Regulatory & Oversight	Government/Policy-Related	Ha et al. (2023), Ebekozien et al. (2021)
	Compliance and Enforcement Issues	Tian and Li (2018), Aghimien et al. (2018), Saha et al. (2022)

4.3.1 High Initial Costs

High initial costs present a significant barrier to the adoption of green building practices, as highlighted by various studies. Wang and Wei (2020) point out that green buildings often involve higher initial costs, which can be a deterrent for developers. Jayantha and Kwong (2018) add that the substantial expenses associated with novel designs and technologies further contribute to these elevated costs. Sabbagh et al. (2019) similarly note that the high initial investment required for green building projects can be a significant obstacle. Wu and Lo (2018) emphasise that capital restraints and construction costs are key factors contributing to the financial challenges faced by developers. Weerasinghe and Ramachandra (2020) also indicate that these higher costs make green building projects less attractive to developers who are seeking quick returns on their investments. Ali et al. (2022) and Samosir et al. (2020) both reinforce the idea that the high upfront costs associated with green buildings are a critical barrier to their widespread adoption.

4.3.2 Financial Constraints

In addition to the high initial costs, financial constraints pose another significant challenge. Wu and Lo (2018) identify financial constraints as a major barrier, while Agyekum et al. (2019) highlight the difficulties in securing funding and the challenges of financing green building projects. Ha et al. (2023) also point to financial constraints as a key obstacle, and Ebekozien et al. (2021) discuss the broader financial-related barriers that hinder the adoption of green building practices.

4.3.3 Market and Transaction Costs

Market and transaction costs contribute to the challenges associated with green buildings. Zhou et al. (2022) explain that transaction costs can impede the market, particularly when dealing with unreliable developers and technologies, further complicating the adoption and implementation of green building initiatives. Collectively, these financial barriers underscore the economic challenges that must be addressed to facilitate the broader adoption of green building practices.

4.3.4 Lack of Skilled Workers

The successful implementation of green building practices is significantly hindered by several organisational and structural barriers, particularly those related to skilled labour, knowledge, awareness, and design challenges. A key barrier is the shortage of skilled workers, as highlighted by Shen et al. (2018) and Sabbagh et al. (2019), who both emphasise the critical lack of skilled labour necessary for the effective adoption of green building practices.

4.3.5 Lack of Knowledge and Skills

In addition to the shortage of skilled workers, there is a notable deficiency in knowledge and technical skills among those involved in green building projects. Cao et al. (2022) point out the lack of understanding of green buildings, which poses a significant challenge to their adoption. Aghimien et al. (2018) further elaborate on this issue, identifying a lack of knowledge and skills in technical aspects, including building materials, project management, control and monitoring methods, architectural design, construction quality, and site management. Ha et al. (2023) add that the lack of technology, training, and overall knowledge further exacerbates these challenges, making it difficult for stakeholders to effectively engage with green building practices.

4.3.6 Lack of Awareness

Another critical barrier is the lack of awareness about green building technologies. Darko et al. (2018) underscores the importance of adopting green building technologies for sustainability but notes that a lack of awareness hampers this adoption. Mouzaneh et al. (2022) support this view, pointing out that there is not only a lack of awareness but also a significant lack of public awareness about the benefits and importance of green buildings.

4.3.7 Design and Planning Challenges

Challenges related to design and planning add further complexity to the adoption of green building practices. Orsi et al. (2020) highlight the need for additional design time, uncertainties regarding special equipment and materials, and the difficulties in planning green activities as major obstacles for designers working on green building projects. Ebekozien et al. (2021) expand on these challenges by identifying organisational and leadership-related barriers, as well as technical and design team-related issues, which complicate the design and implementation process. Cao et al. (2022) also note the uncertain functional positioning of energy conservation technology systems and operational energy efficiency constraints in public buildings as significant design and planning challenges. Together, these barriers underscore the need for improved education, training, and organisational support to overcome the hurdles in the successful implementation of green building initiatives.

4.3.8 Government and Policy-Related

Government and policy-related barriers, as well as issues related to compliance and enforcement, pose significant challenges to the widespread adoption of green building practices. Ha et al. (2023) highlight the impact of political factors, noting that political aspects can hinder the implementation of green building initiatives. Similarly, Ebekozien et al. (2021) identify government and policy-related barriers as critical obstacles that can impede the progress of green building adoption.

4.3.9 Compliance and Enforcement Issues

In addition to these political and policy-related challenges, compliance and enforcement issues further complicate the landscape. Tian and Li (2018) discuss the challenges related to evaluation standards, policies, and consumer efforts, which are essential for the successful implementation of green buildings. Aghimien et al. (2018) point out the additional compliance requirements with green building guidelines and the need for adherence to sustainable design principles, which can be burdensome for developers and stakeholders. Saha et al. (2022) add to this by identifying poor regulation of building code enforcement, a lack of green building products and services, and insufficient research and development as significant barriers. These issues highlight the need for stronger regulatory frameworks, better enforcement mechanisms, and increased support for research and development to overcome the challenges in promoting green building practices.

Figure 2 below illustrates the primary barriers to the adoption of green buildings, along with the number of references supporting each barrier. Key challenges such as "High Initial Costs," "Lack of Awareness," and "Financial Constraints" are highlighted as significant obstacles. These factors reflect both economic and organisational challenges that need to be addressed to promote sustainable building practices.

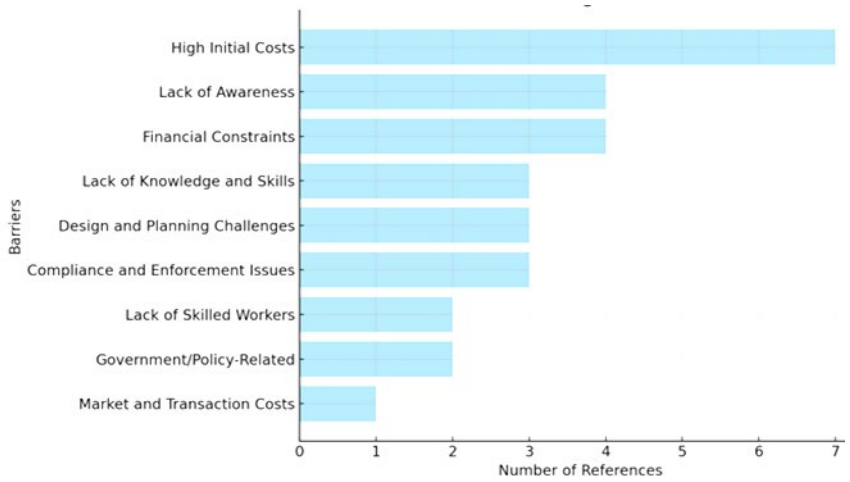

Figure 2 Challenges and barriers for green building development

■5.0 CONCLUSION

The study provides a comprehensive review of the benefits and barriers associated with green buildings, highlighting their crucial role in advancing sustainable development. Green buildings offer significant environmental, economic, and social advantages. Environmentally, they help reduce energy consumption, lower carbon emissions, and improve water and air quality. Economically, they lead to long-term cost savings through reduced operational and maintenance expenses, increased property value, and potentially higher returns on investment. Socially, green buildings enhance occupant health and productivity, foster community engagement, and promote overall well-being.

However, the widespread adoption of green buildings is hindered by several barriers, including high initial construction costs, a shortage of skilled professionals, limited public awareness, and regulatory challenges. Traditional building practices, coupled with concerns about profitability and financial risks, also impede the growth of green building projects.

To overcome these challenges, future research should focus on exploring regional and contextual variations in green building effectiveness, particularly in developing countries with differing regulatory frameworks and economic conditions. Additionally, further studies are needed to develop strategies that address the identified barriers, such as policy interventions, financial incentives, and public education initiatives. Understanding the long-term economic and social impacts of green buildings will be essential in driving their broader adoption and aligning them with global sustainability goals.

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