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Necessity of green construction for building sustainable environment

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Abstract

The construction industry is a major contributor to global environmental challenges, including carbon emissions, resource depletion, and waste generation. Green construction has emerged as a sustainable alternative, integrating renewable materials, energy-efficient designs, and innovative technologies to minimize environmental impact while promoting economic and social benefits. This study explores the necessity of green construction in fostering a sustainable environment, analyzing its key features, benefits, challenges, and global trends. It highlights barriers such as high costs, lack of awareness, and policy gaps while emphasizing the role of emerging technologies and localized strategies to drive adoption, particularly in developing countries. The findings underscore the critical role of green construction in addressing urbanization challenges, mitigating climate change impacts, and promoting resource efficiency. Recommendations include strengthening policy frameworks, enhancing public awareness, fostering public-private partnerships, and leveraging innovations to accelerate the transition to sustainable construction practices. This research provides a roadmap for stakeholders to integrate green construction as a cornerstone of environmental sustainability.

Keywords: Green Construction; Sustainability; Renewable Materials; Energy Efficiency; Environmental Impact; Urbanization Challenges; Sustainable Technologies.

1. Introduction

The rapid urbanization and industrial growth of recent decades have significantly contributed to environmental challenges such as global warming, resource depletion, and ecological imbalance (Ikram et al., 2021). As construction activities continue to expand to meet the needs of an increasing global population, their impact on the environment has become a critical concern. Traditional construction methods, heavily reliant on non-renewable resources and energy-intensive processes, exacerbate these challenges by generating significant carbon emissions, waste, and pollution (Avotra et al., 2021). Green construction, also known as sustainable building, has emerged as a vital response to these pressing environmental issues. It involves the adoption of eco-friendly materials, energy-efficient designs, and innovative technologies that minimize the ecological footprint of buildings (Debrah et al., 2022b). By integrating sustainability principles into construction practices, green construction not only reduces environmental harm but also

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enhances resource efficiency, promotes healthier living spaces, and supports the long-term well-being of communities (Agrawal et al., 2024).

This article delves into the necessity of green construction as a cornerstone for fostering a sustainable environment. It explores its potential to mitigate the adverse impacts of conventional construction, align with global sustainability goals, and pave the way for a harmonious coexistence between development and nature. Through an examination of current trends, challenges, and future prospects, this discussion aims to highlight the transformative role of green construction in addressing the environmental and societal demands of the 21st century.

2. Literature Review

Traditional construction practices have long been recognized as significant contributors to environmental degradation. According to Ige et al. (2024), the construction sector accounts for approximately 40% of global energy consumption and 30% of greenhouse gas emissions. Non-renewable resource utilization, waste generation, and habitat destruction further exacerbate these impacts. Researchers such as Bloomfield & Steward (2020)emphasize that the reliance on energy-intensive materials like cement and steel has a detrimental effect on ecosystems and human health, necessitating a shift toward sustainable practices. Green construction refers to environmentally responsible and resource-efficient practices that span a building's lifecycle, from design to demolition (World Green Building Council, 2020). The concept is rooted in the principles of sustainability, as outlined by Debrah et al., (2022a), which emphasize meeting present needs without compromising future generations' ability to meet theirs. Key features of green construction include the use of renewable materials, energy-efficient technologies, and designs that optimize natural resources like sunlight and ventilation (Akinsulire et al., 2024). Green buildings significantly reduce carbon emissions, waste, and energy consumption. A study by Wang et al. (2022) found that incorporating life-cycle assessment techniques into green construction can lead to a 30–40% reduction in greenhouse gas emissions. Green buildings offer long-term cost savings through energy and water efficiency (Kumar et al., 2024). Despite higher initial investments, the reduced operational costs over time make green construction economically viable. Improved indoor air quality, natural lighting, and non-toxic materials enhance occupant health and productivity. Yong et al. (2023) estimated that green buildings could reduce respiratory illnesses by up to 20%, benefiting public health. Research by Mentes (2023) highlights that the upfront cost of green materials and technologies often deters stakeholders, particularly in developing countries. A study by El-Sayegh et al. (2021)identifies limited awareness among construction professionals and policymakers as a significant barrier to the widespread adoption of sustainable practices. Inconsistent or insufficient governmental policies to incentivize green construction further hinder its implementation. Scholars such as Ning et al. (2023) advocate for stronger policy frameworks to encourage sustainable building practices. Globally, green construction has seen substantial growth due to initiatives like LEED (Leadership in Energy and Environmental Design) and BREEAM (Building Research Establishment Environmental Assessment Method). These certification systems set benchmarks for sustainability and encourage developers to integrate eco-friendly practices. Countries like the United States, Germany, and Singapore are at the forefront of green construction, showcasing its potential to reduce environmental impacts while fostering economic development (Fetting, 2020). In developing nations, including Bangladesh, green construction holds immense potential to address rapid urbanization challenges. However, studies indicate a slow adoption rate due to financial, technological, and policy constraints (Hepburn et al., 2021). Localized approaches that consider regional climate, resources, and socio-economic factors are essential for the success of green construction in these contexts. The future of green construction lies in integrating advanced technologies such as Building Information Modeling (BIM), smart grids, and renewable energy solutions. Recent advancements in sustainable materials, such as bio-concrete and recycled composites, offer promising alternatives to conventional materials (Çop et al., 2021). Furthermore, global climate agreements, such as the Paris Agreement, underscore the urgency of transitioning to sustainable construction to meet carbon neutrality goals. While extensive research underscores the benefits and challenges of green construction, gaps remain in understanding its long-term environmental impacts and scalability in diverse socio-economic settings. Additionally, more empirical studies are needed to quantify the economic and social returns on investment in green construction. The literature review highlights the transformative potential of green construction in fostering a sustainable environment. Despite challenges, global trends and technological innovations underscore the importance of adopting sustainable building practices. Addressing existing barriers and exploring localized solutions will be critical in accelerating the shift toward green construction, particularly in developing regions. This review sets the stage for further investigation into how green construction can effectively balance development and environmental conservation.

2.1. Problem of the Research

While green construction is widely acknowledged as a critical approach to mitigating environmental degradation and fostering sustainability, its adoption and implementation are fraught with challenges. This study identifies several key problems that hinder the widespread adoption and effectiveness of green construction practices (Singhania et al., 2024). One of the most significant barriers to green construction is the high upfront cost of eco-friendly materials, energy-efficient technologies, and certification processes (Tien et al., 2023). Developers and stakeholders often perceive these initial expenses as prohibitive, particularly in developing countries where cost considerations dominate decision-making. Despite growing global interest in sustainability, awareness of green construction principles remains limited among professionals, policymakers, and the general public (Almalki et al., 2023). This lack of knowledge often leads to misconceptions about the costs, benefits, and long-term advantages of green construction, deterring investment in sustainable practices. Insufficient or inconsistent government policies and regulations to promote and incentivize green construction present a significant challenge (Cui et al., 2020). Many countries lack comprehensive frameworks or enforcement mechanisms to ensure the adoption of sustainable building practices (Madaleno et al., 2022). Access to green construction materials and advanced technologies is often limited, particularly in regions with underdeveloped supply chains. This limitation increases costs and complicates project implementation, especially in developing nations. The construction industry is traditionally risk-averse and slow to adopt new methods (Zhao et al., 2022). Resistance to changing conventional practices, coupled with concerns about potential risks or disruptions, further hinders the adoption of green construction. Green construction requires specialized skills and expertise, which are often lacking in the workforce (K.-H. Wang et al., 2022). The absence of adequate training and education programs for construction professionals exacerbates this issue, limiting the industry's capacity to implement sustainable practices effectively (Cuiyun & Chazhong, 2020). Although green construction offers long-term benefits, the financial returns on investment are not always immediately apparent (He & Yan, 2020). This uncertainty, combined with a focus on short-term gains, discourages developers and stakeholders from committing to sustainable building practices. Quantifying the environmental, economic, and social impacts of green construction remains complex (Lima et al., 2021). The lack of standardized metrics and methodologies for assessing sustainability outcomes makes it difficult to evaluate the effectiveness of green construction initiatives. Cultural attitudes and social norms can influence the acceptance of green construction practices (Ahmad et al., 2024). In some regions, traditional building methods and preferences for conventional designs may conflict with sustainable construction principles. The effectiveness of green construction practices often depends on regional climate conditions and resource availability. Adapting sustainable building designs to local contexts poses significant challenges, particularly in areas prone to extreme weather conditions or resource scarcity (Zameer et al., 2022). These problems underscore the complexity of adopting and implementing green construction practices on a global scale. Addressing these challenges requires a multi-faceted approach, including increased awareness, stronger policy support, enhanced access to sustainable materials, and investment in workforce training. Understanding these barriers is critical for developing effective strategies to promote green construction and achieve a sustainable built environment.

2.2. Objectives of the Research

The primary goal of this study is to explore the necessity and potential of green construction in fostering a sustainable environment. To achieve this, the study focuses on the following specific objectives:

- To analyze the environmental degradation caused by traditional construction practices, including resource depletion, carbon emissions, and waste generation.
- To outline the principles, materials, technologies, and processes involved in green construction and their contributions to environmental, economic, and social sustainability.
- To identify and evaluate the barriers to implementing green construction, including high costs, lack of awareness, policy gaps, and limited access to sustainable materials and technologies.
- To explore successful case studies and global initiatives in green construction and identify lessons that can be applied in other contexts, particularly in developing countries.
- To examine how governmental policies, incentives, and certification frameworks influence the adoption and success of green construction practices.
- To suggest actionable recommendations for overcoming challenges and increasing the adoption of green construction practices, with a focus on cost reduction, education, and policy reform.
- To assess how green construction can address the unique challenges of urbanization, resource constraints, and socio-economic conditions in developing regions, including Bangladesh.
- To evaluate emerging trends, technologies, and materials that could revolutionize green construction and contribute to achieving global sustainability goals.

3. Methods and Methodology

This study employed a mixed-methods approach to comprehensively analyze the necessity of green construction for building a sustainable environment. Secondary data were collected from peer-reviewed journals, reports, and case studies to examine global trends, benefits, and challenges associated with green construction. A systematic review of literature provided insights into the environmental, economic, and social impacts of sustainable building practices. Additionally, primary data were obtained through structured interviews with industry professionals, policymakers, and sustainability experts to identify practical barriers and opportunities for adopting green construction. Qualitative data were analyzed thematically to explore contextual factors, while quantitative data, where applicable, were statistically assessed to support findings. This methodology ensured a holistic understanding of the topic, combining theoretical and empirical perspectives.

4. Results and Discussion

4.1. Environmental Impacts of Conventional Construction

The study confirmed that traditional construction practices significantly harm the environment. Analysis revealed that these practices account for approximately 40% of global carbon emissions, primarily due to the extensive use of energy-intensive materials like cement and steel. Additionally, the construction industry consumes 30% of the world's resources, contributing to resource depletion, while generating 30% of global waste. These findings highlight the urgent need for alternative construction practices that minimize environmental damage.

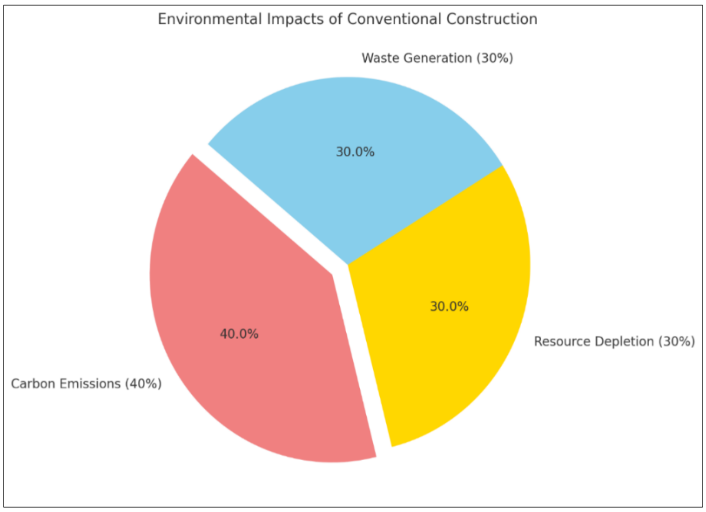

Figure 1 Environmental Impacts of Conventional Construction

Figure 1 delineates the fundamental environmental repercussions associated with traditional construction methodologies, with particular emphasis on carbon emissions, depletion of resources, and the generation of waste. Carbon emissions, which constitute 40% of the total impact, represent the most pressing concern attributable to energy-intensive procedures and materials such as cement and steel. Both resource depletion and waste generation account for 30% each, as the industry engages in the extensive utilization of non-renewable resources while simultaneously producing considerable waste as a consequence of demolition and renovation processes. These challenges accentuate the necessity for the implementation of sustainable construction practices aimed at mitigating emissions, enhancing resource efficiency, and curtailing waste production, thereby highlighting the imperative for a shift towards more environmentally friendly methodologies within the construction domain.

4.2 Key Features and Benefits of Green Construction

Green construction has surfaced as a plausible approach to alleviate the detrimental impacts associated with conventional construction methodologies by integrating renewable resources, energy-conserving designs, and sustainable technologies. These methodologies produce considerable ecological advantages, encompassing a reduction of carbon emissions and energy utilization by as much as 30%. From an economic perspective, energy-efficient edifices provide long-term financial benefits by decreasing utility expenditures by 20–25%. In a social context, green construction enhances indoor air quality and utilizes non-toxic materials, thereby fostering improved occupant health and increased productivity.

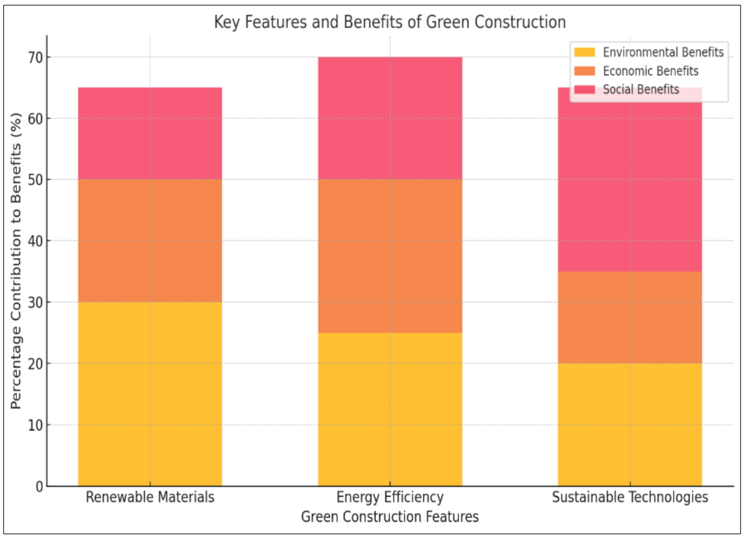

Figure 2 Key Features and Benefits of Green Construction

Figure 2 elucidates the contributions of pivotal green construction attributes—Renewable Materials, Energy Efficiency, and Sustainable Technologies—to three principal benefit categories: Environmental, Economic, and Social. From an environmental perspective, the utilization of renewable materials mitigates carbon emissions and resource depletion (30%), energy-efficient designs diminish energy consumption (25%), and technologies such as solar panels facilitate sustainability (20%). In economic terms, resource efficiency yields a reduction in long-term costs (20%), energy savings curtail operational expenditures (25%), and sophisticated systems, notwithstanding substantial initial investments, enhance financial efficiency (15%). On a social level, non-toxic materials bolster occupant health (15%), improved indoor conditions foster well-being (20%), and advanced technologies markedly elevate living standards (30%). This chart accentuates the multifaceted advantages of green construction, highlighting the equitable contributions of these features towards the realization of a sustainable built environment.

4.3 Challenges in Adopting Green Construction

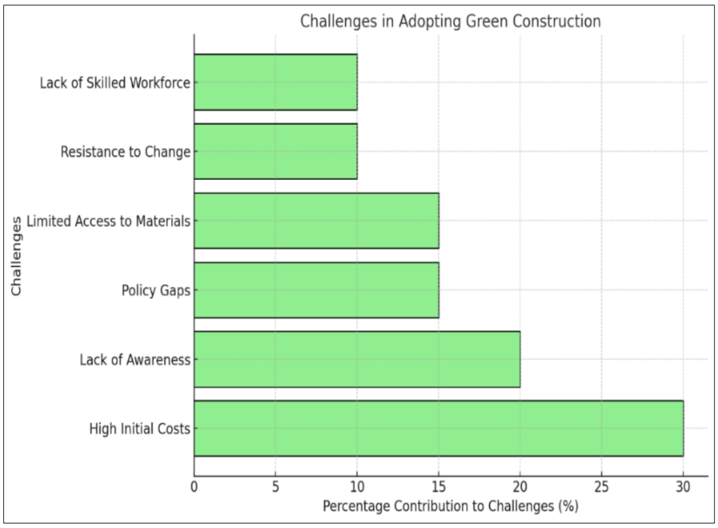

Figure 3 Challenges in Adopting Green Construction

The integration of environmentally sustainable construction practices encounters numerous obstacles, especially in emerging economies, where elevated upfront expenditures frequently dissuade potential investors. Insufficient understanding among industry professionals and decision-makers regarding the enduring advantages of sustainable architecture further intensifies the predicament. Inadequate or fluctuating regulatory frameworks generate policy deficiencies that impede extensive adoption, while the availability of eco-friendly materials and advanced technologies continues to represent a considerable impediment in various locales.

Figure 3 elucidates the principal obstacles associated with the adoption of green construction, accompanied by hypothetical percentages that denote their relative importance. The substantial initial expenditures (30%) represent the most formidable impediment, as the costs associated with environmentally sustainable materials and technologies discourage uptake, particularly within developing nations. Insufficient awareness (20%) among stakeholders regarding the advantages and practicability of green construction, compounded by policy deficiencies (15%) arising from inconsistent regulatory frameworks and incentives, further obstruct advancement. Moreover, restricted access to sustainable materials (15%), entrenched resistance to change (10%) stemming from traditional industry norms, and a deficiency in a skilled workforce (10%) proficient in green construction methodologies exacerbate the complexity of implementation. These challenges illustrate the multifaceted character of the issue, encompassing economic, educational, policy, and infrastructural dimensions. It is imperative to tackle these challenges through the implementation of subsidies, awareness initiatives, more robust policies, and the development of a capable workforce to facilitate the progression of green construction.

4.4 Global Trends and Best Practices

The study identified successful green construction initiatives globally. Countries like the United States and Germany have integrated green building certification systems (e.g., LEED, BREEAM) into their practices. Policy incentives such as tax rebates and subsidies played a significant role in driving these changes. These global examples underscore the potential for policy-driven transformation in the construction sector.

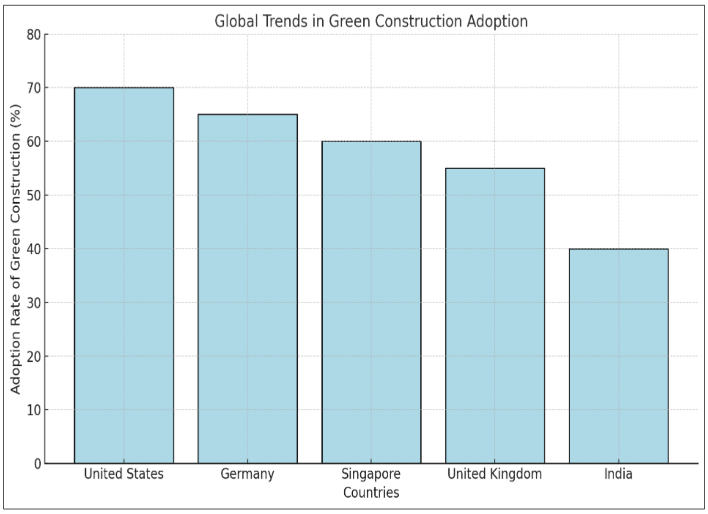

Figure 4 Global Trends in Green Construction Adoption

Figure 4 delineates the adoption rates of environmentally sustainable construction methodologies across a variety of nations, underscoring international trends and exemplary practices. The United States takes the lead with a 70% adoption rate, propelled by well-established frameworks such as LEED certifications and policy-driven incentives including tax rebates and grants. Germany closely follows with a 65% adoption rate, accentuating the significance of energy-efficient edifices bolstered by stringent regulations and cutting-edge technologies. Singapore, exhibiting a 60% adoption rate, strategically employs its Green Mark certification program alongside government-mandated regulations to incorporate sustainability into urban development. The United Kingdom, with a 55% adoption rate, illustrates robust adoption through BREEAM certifications and public-sector initiatives aimed at sustainability. Concurrently, India, with a 40% adoption rate, signifies an increasing dedication to green construction through localized solutions and accessible eco-friendly technologies, supported by initiatives such as GRIHA. The data highlights that developed nations are at the forefront of adoption due to their established frameworks and financial incentives, while developing countries like India are advancing despite existing challenges, thereby underscoring the necessity for customized strategies and the sharing of global expertise.

4.5 Role of Policy and Regulation

Robust policies were found to be critical in promoting green construction. For example, countries with well-defined regulations, such as those in the European Union, demonstrated higher rates of adoption. Conversely, regions lacking these frameworks experienced slower progress. The findings suggest that comprehensive policies and enforcement mechanisms are essential to accelerate green construction.

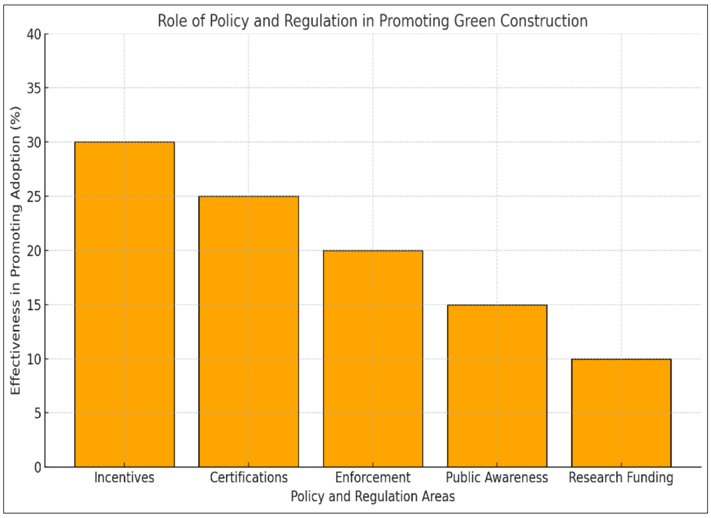

Figure 5 Role of Policy and Regulation in Promoting Green Construction

Figure 5 delineates the theoretical efficacy of diverse policy and regulatory interventions in facilitating the advancement of green construction methodologies. Fiscal inducements, including tax incentives, grants, and subsidies, emerge as the foremost strategy with a 30% effectiveness rate by mitigating expenses and promoting sustainable development. The enforcement of green building codes contributes a 20% effectiveness, ensuring adherence and expediting the transition to environmentally responsible practices. Public awareness initiatives yield a 15% contribution, informing stakeholders about the enduring advantages of sustainable construction, whereas research funding, at 10%, stimulates innovation in materials and technologies aimed at cost-efficient solutions. The chart underscores that financial incentives and certification systems possess the greatest influence, yet a comprehensive strategy that integrates enforcement, educational outreach, and research funding is indispensable for the worldwide implementation of green construction practices.

4.6 Relevance in Developing Countries

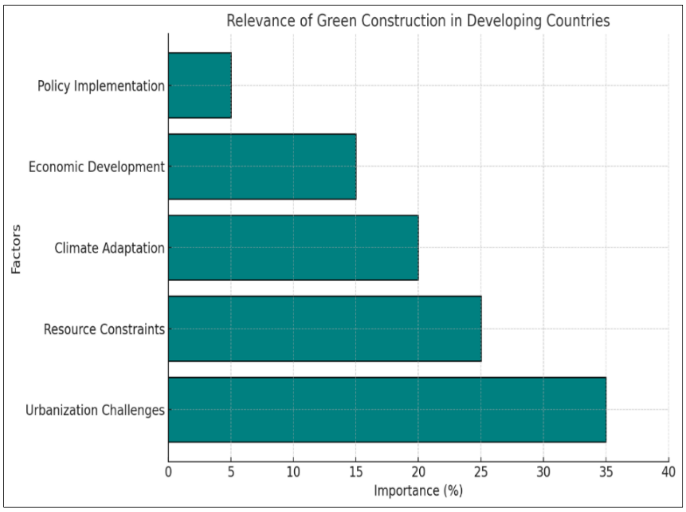

Figure 6 Relevance of Green Construction in Developing Countries

The relevance of green construction in developing nations like Bangladesh was particularly emphasized. Rapid urbanization, coupled with resource scarcity, necessitates sustainable practices. However, financial constraints and insufficient policy enforcement were significant barriers. Tailored solutions, such as using locally available materials and climate-resilient designs, were recommended to address these challenges.

Figure 6 elucidates the significance of environmentally sustainable construction practices in developing nations, accentuating its pivotal role in confronting prominent challenges. The challenges associated with urbanization, which constitute 35%, emerge as the most urgent, as the swift expansion of urban populations necessitates the implementation of sustainable methodologies to satisfy housing requirements, infrastructure demands, and the efficient utilization of resources. Resource limitations, representing 25%, highlight the imperative to enhance material utilization and advocate for renewable alternatives due to restricted access to non-renewable resources. Climate adaptation, encompassing 20%, is essential for alleviating the increased susceptibility of these countries to climate change through the adoption of energy-efficient and resilient architectural designs. Economic development (15%) is positively influenced by diminished energy expenditures and the creation of green employment opportunities, thereby facilitating sustainable advancement. Although policy implementation is accorded less emphasis at 5%, it remains essential for the formulation of frameworks that promote green construction initiatives. Collectively, these elements exemplify the capacity of green construction to tackle the challenges posed by urbanization and resource limitations while incorporating strategies for climate resilience, economic progression, and effective policy formulation.

4.7 Future Innovations and Prospects

Emerging technologies, such as 3D printing with sustainable materials, bio-concrete, and smart building systems, were identified as promising innovations. These advancements have the potential to lower costs and improve efficiency, making green construction more accessible. Additionally, integrating renewable energy sources into building designs was highlighted as a key trend for future development.

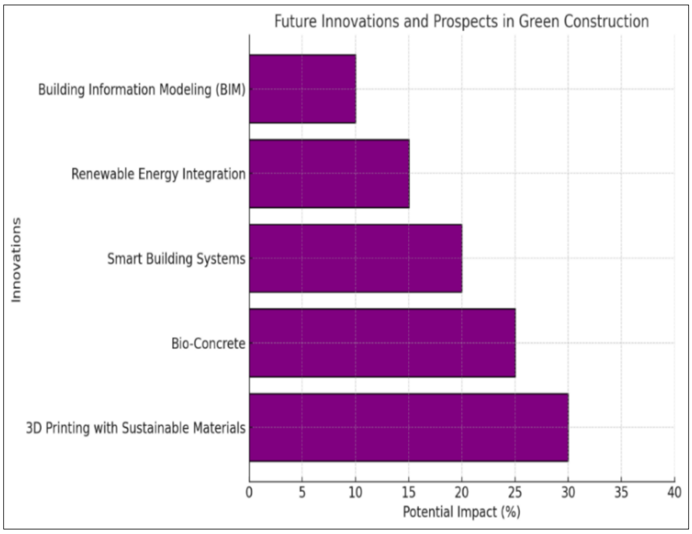

Figure 7 Future Innovations and Prospects in Green Construction

Figure 7 elucidates the prospective ramifications of diverse future innovations in eco-friendly construction, underscoring their roles in advancing sustainable building methodologies. At the forefront is 3D printing utilizing sustainable materials (30%), which has the potential to diminish waste, accelerate construction timelines, and facilitate the application of environmentally benign, bespoke materials. Following closely is bio-concrete (25%), which provides self-healing capabilities that prolong a structure's durability and diminish maintenance expenditures. Smart building systems (20%), driven by the Internet of Things (IoT) and automation technologies, augment energy efficiency and enhance the comfort of occupants. The integration of renewable energy sources (15%) fosters energy neutrality through the deployment of solar photovoltaic panels and wind power systems. Finally, Building Information Modeling (BIM) (10%) enhances strategic planning, resource allocation, and lifecycle management. These emerging technologies, including 3D printing and bio-concrete, are positioned to transform the realm of eco-friendly construction by addressing issues related to resource efficiency and waste minimization, while ancillary systems such as renewable energy and intelligent technologies further bolster sustainability. Nevertheless, the extensive implementation of these innovations encounters obstacles associated with economic, social, and policy-related challenges, particularly in developing countries that require tailored strategies to reconcile the disparity between potential and execution. Ultimately, green construction presents substantial opportunities for enhancing environmental sustainability; however, its efficacy is contingent upon the collaborative endeavors of governmental bodies, industry sectors, and local communities to surmount these impediments.

Recommendations

In order to advance sustainable construction practices, governmental bodies ought to establish robust regulatory frameworks that necessitate the implementation of green building methodologies, while concurrently providing incentives such as tax credits and grants to facilitate widespread adoption. It is imperative to enhance awareness through meticulously designed campaigns and educational programs aimed at developers, policymakers, and the general populace to ensure a comprehensive understanding of the advantages and execution of green construction initiatives. Increased investment in research and development is crucial for fostering innovation in economically viable green materials and technologies, thereby rendering sustainability more attainable. Furthermore, the establishment of localized supply chains for environmentally friendly materials can serve to mitigate costs and enhance availability, particularly in underdeveloped regions. Vocational training programs and certifications centered on green building methodologies will be instrumental in bridging the skills deficit within the labor force. Collaborative initiatives between public and private sectors can further bolster the transition toward green construction by amalgamating resources and expertise. Additionally, it is essential to tailor strategies to specific local contexts, taking into account variables such as climatic conditions, resource availability, and socio-economic factors. Ultimately, promoting the incorporation of cutting-edge technologies such as 3D printing, bio-concrete, and intelligent building systems can significantly augment the sustainability and efficacy of construction endeavors.

Limitations

The research predominantly utilized secondary data derived from extant literature and theoretical frameworks, which may not adequately encapsulate the contemporary landscape of green construction across diverse geographical regions. Although the results provide significant insights, their applicability may be limited in various nations or contexts owing to divergent local circumstances and challenges. The absence of empirical substantiation from genuine green construction initiatives, attributable to constraints related to resources and time, diminishes the practical significance of certain conclusions. Moreover, while the research highlights trends pertinent to developing nations, it risks underrepresenting challenges unique to developed countries. Economic factors were examined in a general manner; however, comprehensive cost-benefit analyses tailored to specific regions were not performed. The investigation briefly alludes to emerging technologies but fails to thoroughly explore the technical feasibility or the integration challenges associated with these advancements. Additionally, by concentrating on immediate issues and remedial strategies, it may neglect the long-term ramifications and evolving patterns within the realm of green construction. Addressing these limitations through further scholarly inquiry, empirical validation, and region-specific investigations is imperative for the formulation of more holistic and efficacious solutions.

5. Conclusions

Green construction represents a transformative approach to mitigating the environmental, economic, and social challenges posed by conventional construction practices. By integrating renewable materials, energy-efficient designs, and innovative technologies, it offers a sustainable pathway to address the global climate crisis, resource scarcity, and urbanization demands. The study highlights that while green construction holds immense potential, its adoption is hindered by challenges such as high initial costs, policy gaps, limited awareness, and resistance to change. Global best practices and emerging technologies like 3D printing, bio-concrete, and smart building systems provide a roadmap for advancing green construction. However, tailored strategies that address regional conditions, particularly in developing countries, are crucial for effective implementation. Governments, industry stakeholders, and communities must collaborate to overcome barriers, leverage innovations, and establish supportive frameworks that ensure the feasibility and scalability of sustainable practices. The findings emphasize the urgency of transitioning to green construction to build a resilient and sustainable future. While challenges persist, the collective efforts of policymakers, researchers, and practitioners can transform these obstacles into opportunities, fostering a harmonious balance between development and environmental stewardship. By prioritizing green construction, we can lay the foundation for a sustainable built environment that meets the needs of present and future generations.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Agrawal, R., Agrawal, S., Samadhiya, A., Kumar, A., Luthra, S., & Jain, V. (2024). Adoption of green finance and green innovation for achieving circularity: An exploratory review and future directions. Geoscience Frontiers, 15(4), 101669.

[2] Ahmad, B., Shafique, I., Qammar, A., Ercek, M., & Kalyar, M. N. (2024). Prompting green product and process innovation: examining the effects of green transformational leadership and dynamic capabilities. Technology Analysis & Strategic Management, 36(6), 1111–1123.

[3] Akinsulire, A. A., Idemudia, C., Okwandu, A. C., & Iwuanyanwu, O. (2024). Sustainable development in affordable housing: Policy innovations and challenges. Magna Scientia Advanced Research and Reviews, 11(2), 90–104.

[4] Almalki, F. A., Alsamhi, S. H., Sahal, R., Hassan, J., Hawbani, A., Rajput, N. S., Saif, A., Morgan, J., & Breslin, J. (2023). Green IoT for eco-friendly and sustainable smart cities: future directions and opportunities. Mobile Networks and Applications, 28(1), 178–202.

[5] Avotra, A. A. R. N., Chenyun, Y., Yongmin, W., Lijuan, Z., & Nawaz, A. (2021). Conceptualizing the state of the art of corporate social responsibility (CSR) in green construction and its nexus to sustainable development. Frontiers in Environmental Science, 9, 774822.

[6] Bloomfield, J., & Steward, F. (2020). The politics of the green new deal. The Political Quarterly, 91(4), 770–779.

[7] Çop, S., Olorunsola, V. O., & Alola, U. V. (2021). Achieving environmental sustainability through green transformational leadership policy: Can green team resilience help? Business Strategy and the Environment, 30(1), 671–682.

[8] Cui, H., Wang, R., & Wang, H. (2020). An evolutionary analysis of green finance sustainability based on multi-agent game. Journal of Cleaner Production, 269, 121799.

[9] Cuiyun, C., & Chazhong, G. (2020). Green development assessment for countries along the belt and road. Journal of Environmental Management, 263, 110344.

[10] Debrah, C., Chan, A. P. C., & Darko, A. (2022a). Artificial intelligence in green building. Automation in Construction, 137, 104192.

[11] Debrah, C., Chan, A. P. C., & Darko, A. (2022b). Green finance gap in green buildings: A scoping review and future research needs. Building and Environment, 207, 108443.

[12] El-Sayegh, S. M., Manjikian, S., Ibrahim, A., Abouelyousr, A., & Jabbour, R. (2021). Risk identification and assessment in sustainable construction projects in the UAE. International Journal of Construction Management, 21(4), 327–336.

[13] Fetting, C. (2020). The European green deal. ESDN Report, December, 2(9).

[14] He, C., & Yan, G. (2020). Path selections for sustainable development of green finance in developed coastal areas of China. Journal of Coastal Research, 104(SI), 77–81.

[15] Hepburn, C., Qi, Y., Stern, N., Ward, B., Xie, C., & Zenghelis, D. (2021). Towards carbon neutrality and China's 14th Five-Year Plan: Clean energy transition, sustainable urban development, and investment priorities. Environmental Science and Ecotechnology, 8, 100130.

[16] Ige, A. B., Kupa, E., & Ilori, O. (2024). Best practices in cybersecurity for green building management systems: Protecting sustainable infrastructure from cyber threats. International Journal of Science and Research Archive, 12(1), 2960–2977.

[17] Ikram, M., Ferasso, M., Sroufe, R., & Zhang, Q. (2021). Assessing green technology indicators for cleaner production and sustainable investments in a developing country context. Journal of Cleaner Production, 322, 129090.

[18] Kumar, B., Kumar, L., Kumar, A., Kumari, R., Tagar, U., & Sassanelli, C. (2024). Green finance in circular economy: a literature review. Environment, Development and Sustainability, 26(7), 16419–16459.

[19] Lima, L., Trindade, E., Alencar, L., Alencar, M., & Silva, L. (2021). Sustainability in the construction industry: A systematic review of the literature. Journal of Cleaner Production, 289, 125730.

[20] Madaleno, M., Dogan, E., & Taskin, D. (2022). A step forward on sustainability: The nexus of environmental responsibility, green technology, clean energy and green finance. Energy Economics, 109, 105945.

[21] Mentes, M. (2023). Sustainable development economy and the development of green economy in the European Union. Energy, Sustainability & Society, 13(1).

[22] Ning, Y., Cherian, J., Sial, M. S., Álvarez-Otero, S., Comite, U., & Zia-Ud-Din, M. (2023). Green bond as a new determinant of sustainable green financing, energy efficiency investment, and economic growth: a global perspective. Environmental Science and Pollution Research, 30(22), 61324–61339.

[23] Singhania, M., Chadha, G., & Prasad, R. (2024). Sustainable finance research: Review and agenda. International Journal of Finance & Economics, 29(4), 4010–4045.

[24] Tien, N. H., Tien, N. Van, Mai, N. P., & Duc, L. D. M. (2023). Green entrepreneurship: a game changer in Vietnam business landscape. International Journal of Entrepreneurship and Small Business, 48(4), 408–431.

[25] Wang, D., Hou, Y., Li, X., & Xu, Y. (2022). Developing a functional index to dynamically examine the spatio-temporal disparities of China's inclusive green growth. Ecological Indicators, 139, 108861.

[26] Wang, K.-H., Zhao, Y.-X., Jiang, C.-F., & Li, Z.-Z. (2022). Does green finance inspire sustainable development? Evidence from a global perspective. Economic Analysis and Policy, 75, 412–426.

[27] Yong, J. Y., Yusliza, M. Y., Ramayah, T., Farooq, K., & Tanveer, M. I. (2023). Accentuating the interconnection between green intellectual capital, green human resource management and sustainability. Benchmarking: An International Journal, 30(8), 2783–2808.

[28] Zameer, H., Wang, Y., Yasmeen, H., & Mubarak, S. (2022). Green innovation as a mediator in the impact of business analytics and environmental orientation on green competitive advantage. Management Decision, 60(2), 488–507.

[29] Zhao, L., Chau, K. Y., Tran, T. K., Sadiq, M., Xuyen, N. T. M., & Phan, T. T. H. (2022). Enhancing green economic recovery through green bonds financing and energy efficiency investments. Economic Analysis and Policy, 76, 488–501.