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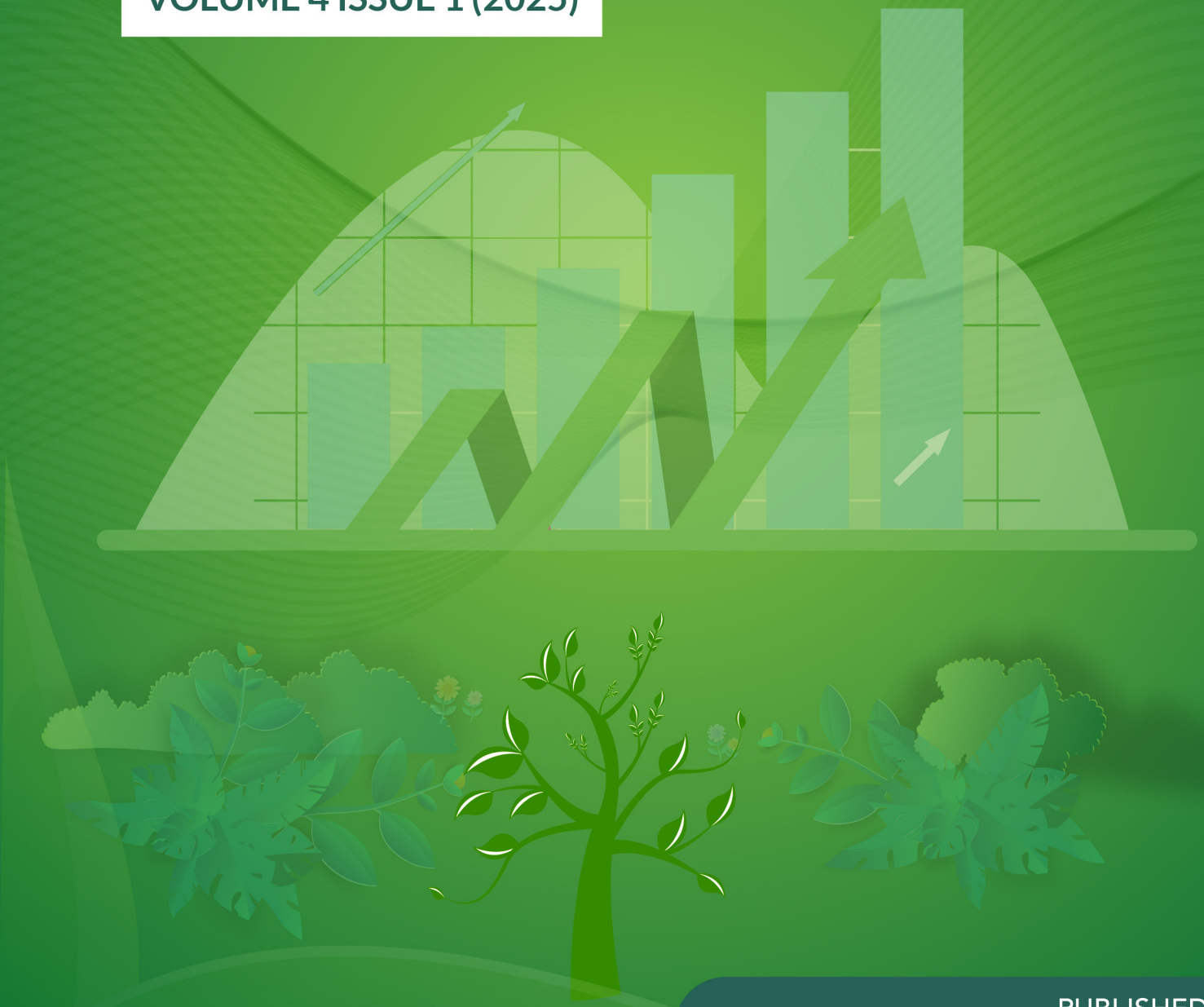

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Achieving Carbon-Neutral Construction: Global Trends and Bangladesh's Sustainable Future

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ABSTRACT

The construction industry is a major contributor to climate change, with buildings accounting for over 40% of worldwide CO_2 emissions. In rising countries like Bangladesh, achieving carbon-neutral buildings has emerged as a crucial goal in global sustainability initiatives. Bangladesh has particular difficulties in striking a balance between the requirement for environmental sustainability and its fast urbanization and economic growth. Although there are green building technologies and practices available, high costs, restricted access to green financing, a lack of local knowledge, and a lack of government support are preventing carbon-neutral construction from being widely adopted. These obstacles hamper the shift to more energy-efficient and sustainable building techniques.. This paper examines worldwide developments in carbon-neutral building techniques as well as the unique obstacles Bangladesh must overcome to use them. It looks at the particular challenges faced by Bangladesh, such as budgetary limitations, technology deficiencies, and ineffective policies. The study provides strategic recommendations, including more funding for green infrastructure, easier access to green financing, and greater public-private cooperation, by examining successful green building projects in other nations. It highlights how crucial government incentives and policy changes are to promoting environmentally friendly building methods. In the end, this study offers a solution for Bangladesh to create a carbon-neutral building industry, supporting international sustainability objectives and meeting the country's housing demands and fast urbanization.

INTRODUCTION

Buildings are responsible for around 40% of global CO_2 emissions, making the construction industry a major contributor to carbon emissions (UNEP, 2022). With an emphasis on sustainable practices including energy-efficient materials, renewable energy, and carbon-capturing technologies, achieving carbon-neutral building has emerged as a crucial objective in the fight against climate change. However, obstacles include financial, technological, and policy-related difficulties plague emerging countries. Bangladesh faces particular difficulties in striking a balance between environmental sustainability and economic growth because of its fast urbanization and susceptibility to climate change. The broad adoption of carbon-neutral construction is hindered by high costs, insufficient green funding, and a lack of qualified labor, despite advancements in the adoption of green building standards such as LEED certification and energy-efficient norms. This paper explores at global trends in carbon-neutral building as well as the unique opportunities and constraints faced by Bangladesh. It provides a path for a sustainable and carbon-neutral building sector in Bangladesh by highlighting approaches and solutions to overcome obstacles and referencing both domestic and successful global examples.

LITERATURE REVIEW

The United Nations Environment Programme (UNEP, 2022) reports that 39% of global CO_2 emissions in 2022 came from the building sector which makes it one of the biggest contributors to carbon emissions worldwide. This has sparked a boom in studies on carbon-neutral and sustainable building, especially in developing nations where implementing green building techniques is frequently more difficult. Numerous scholarly works highlight the technological, cultural, policy, and economic obstacles that hinder the shift to low-carbon building. The high initial cost of implementing sustainable materials and technology is one of the major issues that has been identified globally. For developers in low-income countries, green materials like cross-laminated lumber, low-carbon cement, and energy-efficient windows are economically unaffordable because they are frequently 30–40% more expensive than conventional materials (Hossain & Ahmed, 2022). Another significant limitation is the absence of reasonably priced financing options. A significant financial burden for developing nations like Bangladesh, the building industry is expected to need $5 trillion a year by 2030 to achieve carbon-neutral targets, according to the World Economic Forum (2022). According to studies by Strøm (2021) and Goh

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and Shafique (2022), only 15% of necessary investments in nations like Bangladesh come from green finance sources, such as green bonds and concessional loans (Bangladesh Climate Resilience Plan, 2023). In nations with tight budgets, the adoption of sustainable building methods is slowed down by the restricted availability of green funding, which further exacerbates economic obstacles. An additional significant barrier, particularly in low- and middle-income nations, is technological. Even though wealthy nations like the US and Singapore have made great strides in carbon-neutral technology, such as energy-efficient machinery and carbon capture systems, developing countries frequently find it difficult to obtain and afford these innovations (Chassagnon, 2023). Bangladesh, for example, uses a lot of old building materials and techniques, like Portland cement and burnt clay bricks, which are high in carbon and do not meet current sustainable building requirements (IPCC, 2023). Furthermore, a major portion of sophisticated construction technologies, including energy-efficient HVAC systems, modular construction, and sustainable building materials, are imported, which raises project costs because of tariffs, logistical difficulties, and maintenance requirements (Xie & Tan, 2022). Only a small percentage of experts in Bangladesh are trained in sustainable building technology, indicating a serious lack of local competence. The broad use of carbon-neutral building practices is hampered by a shortage of trained workers in fields like advanced material science and renewable energy integration (Hossain & Sultana, 2022; Uddin & Alam, 2023). Underdeveloped supply chains for sustainable materials, which are still scarce and frequently not produced locally, worsen this technical divide and cause additional expenses and delays for building projects (Rahman & Sayeed, 2022). Green building policies are sometimes disjointed and uneven, especially in developing nations. Many countries, including Bangladesh, lack a comprehensive, legally binding framework for encouraging sustainable building practices, even though some have adopted green building codes and certification programs like LEED (Leadership in Energy and Environmental Design) (Chattopadhyay & Rahman, 2022). Bangladesh has environmental laws in effect, but there are no particular rules for carbon-neutral building, as Kazi and Sattar (2022) point out, which causes uneven implementation throughout the industry. Furthermore, developers are deterred from pursuing sustainable construction by the lack of incentives, such as tax exemptions or subsidies for green projects (Hashem & Hossain, 2023). Developers are frequently motivated to reduce upfront expenses, which take precedence over long-term financial and environmental gains. Long approval procedures and bureaucratic inefficiencies for green projects further discourage stakeholders from implementing creative, sustainable practices (Hossain & Sultana, 2022). The adoption of carbon-neutral buildings is severely hampered by these legal gaps, which also make it challenging for construction companies to adopt more environmentally friendly procedures. A further major hurdle that affects how quickly green building techniques are implemented is cultural opposition. According to Malik and Mollah (2023), traditional building methods predominate in Bangladesh, where developers and construction workers frequently have doubts about novel, untested materials and techniques. Despite having a large carbon footprint, these conventional materials—such as cement and clay bricks—are favoured because they are regarded as dependable, affordable, and long-lasting (Chattopadhyay & Rahman, 2022). Additionally, many professionals in the building industry are unaware of the long-term economic and environmental advantages of implementing carbon-neutral technologies (Zhang & Jin, 2021). According to Malik and Mollah (2023), there is a notable knowledge gap in Bangladesh, especially among the workforce, which is frequently undereducated and resistant to change. Because clients seek instant affordability over long-term investment in green technologies, developers, particularly in the cheap housing sector, frequently put short-term cost savings ahead of sustainability (Nahar, 2021). According to Peters and Fridley (2023), the lack of appropriate training programs exacerbates the cultural inertia towards adopting sustainable practices by impeding the mass transmission of knowledge about new construction techniques and technology. Building climate-resilient, carbon-neutral infrastructure is made more difficult by Bangladesh's extreme susceptibility to natural catastrophes including floods and cyclones (USAID, 2024). Infrastructure is severely damaged by these regular disasters, increasing the cost and complexity of retrofitting and reconstruction projects. The issue is further exacerbated by the nation's fast urbanisation, especially in places like Dhaka. The construction industry is under tremendous pressure to strike a compromise between the need for inexpensive housing and the necessity of applying sustainable building techniques due to the city's population expansion, which requires 300,000 additional housing units annually (Hossain & Ahmed, 2022). When combined with the lack of green funding and technical know-how, this urban growth creates a special obstacle to incorporating green building techniques into the nation's development (Poudel & Gautam, 2021). Despite these many obstacles, other nations dealing with comparable problems have offered some encouraging answers. Bangladesh can learn from the Philippines' successful use of recycled materials in post-disaster housing, which provides a paradigm for incorporating sustainable materials into catastrophe rehabilitation (Ghosh & Chowdhury, 2021). In order to encourage investment in low-carbon building technology, Bangladesh should follow the example of China, which has instituted government-led programs to offer financial incentives for green construction (Zhang & Jin, 2021).

MATERIALS AND METHODS

This study uses a qualitative methodology and secondary data to investigate the opportunities and problems

associated with carbon-neutral buildings in Bangladesh. The study is based on a thorough analysis of the body of literature, which includes scholarly works, government documents, reports from international organizations, and case studies of international green building projects. With an emphasis on the particular challenges encountered by Bangladesh, the secondary data was examined to find important themes and trends in carbon-neutral buildings. In order to evaluate the data, make links between local context and global practices, and offer suggestions for ways to get beyond obstacles to sustainable building, qualitative analysis was used. This approach enables a thorough comprehension of the problems and makes it easier to create useful suggestions for encouraging carbon-neutral buildings in Bangladesh.

Analysis

The building industry, which accounts for 39% of worldwide carbon emissions, confronts significant financial obstacles when it comes to adopting sustainable practices. Globally, this shift will be extremely expensive; by 2030, it will cost almost $5 trillion a year to implement cutting-edge technologies and environmentally friendly materials. The high cost of sustainable materials and the upfront expenditures needed for green technologies are the causes of these expenses. For example, many developers, especially in low- and middle-income nations, cannot afford materials like cross-laminated lumber and low-carbon cement since they are 30–40% more expensive than conventional alternatives. These worldwide issues are exacerbated in Bangladesh by financial limitations. Only 2-3% of GDP is devoted to climate-related projects, such as sustainable infrastructure, indicating the nation's limited financial capacity to finance green construction. Particularly in a developing country with rapid urbanization and strong housing demand, this amount of investment is not enough to meet the growing need for carbon-neutral development. Furthermore, the financial strain is made worse by the dearth of green financing options like green bonds and concessional loans. There is a huge funding gap in the building industry since green financing only accounts for 15% of the necessary investments. Adoption of sustainable materials and methods is further discouraged by developers' and investors' frequent lack of access to customized finance solutions. Bangladesh finds it challenging to reach its carbon-neutral building targets due to high costs, a lack of government support, and limited access to green financing, highlighting the need for strategic initiatives and outside assistance. Following graphs and charts can show it better:

GDP Allocation for Climate Projects

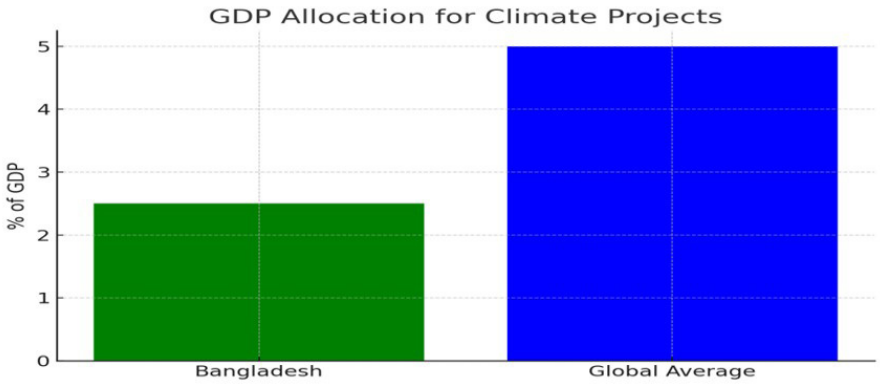

Figure 1: GDP allocation for climate projects

The graph contrasts Bangladesh's (about 2.5%) GDP share allotted to climate-related initiatives with the global average (5%). The data reveals a notable discrepancy, highlighting Bangladesh's insufficient financial capacity to adequately address climate concerns, especially in sustainable practices and green construction. The country's capacity to move towards carbon-neutral infrastructure is hampered by this insufficient funding, particularly in light of its strong housing demand and fast urbanization.

Cost Comparison of Building Materials

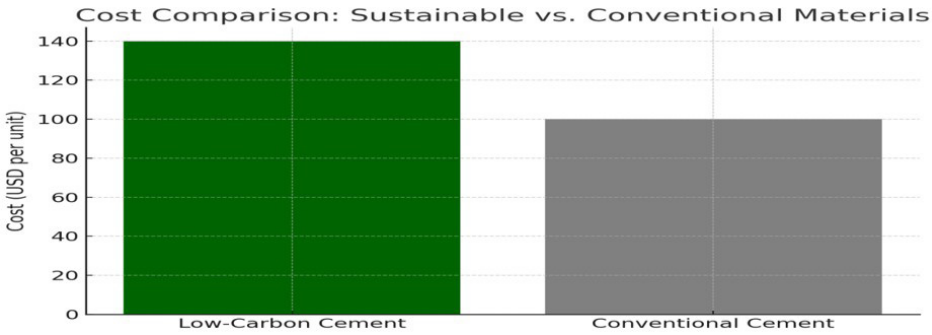

Figure 2: Cost Comparison of Building Materials

The graph illustrates the price of ordinary cement with low-carbon cement, which is a sustainable material. One major financial obstacle to the adoption of low-carbon cement is its about 40% higher cost. This price difference deters developers from utilizing sustainable building materials, especially in low- and middle-income nations like Bangladesh.

Green Financing Contribution

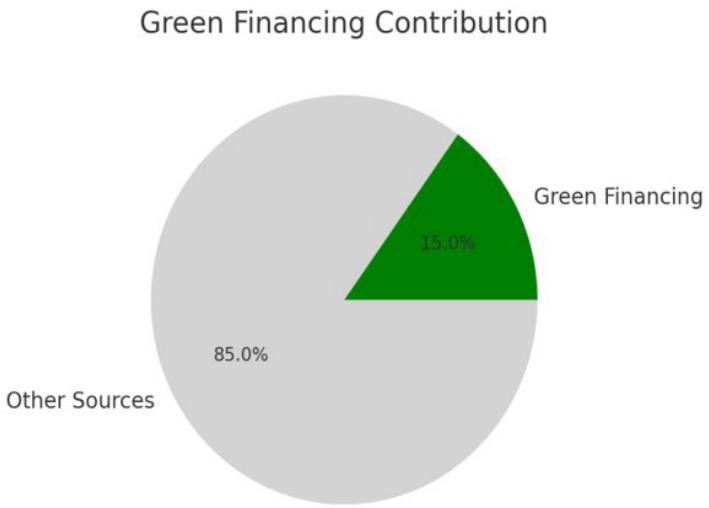

Figure 3: Green Financing Contribution

The contribution of green financing to the overall investments required for sustainable construction is depicted in the pie chart. Only 15% of funding comes from green sources; the remaining 85% comes from other sources. This notable disparity draws attention to the dearth of easily available and focused funding sources for sustainable construction methods. This small contribution makes it more difficult for nations like Bangladesh to embrace eco-friendly products and technologies. Accelerating sustainable development and closing this gap could be accomplished by expanding green financing through tools like concessional loans or green bonds.

Budget Allocation: Sustainable vs. Conventional Materials

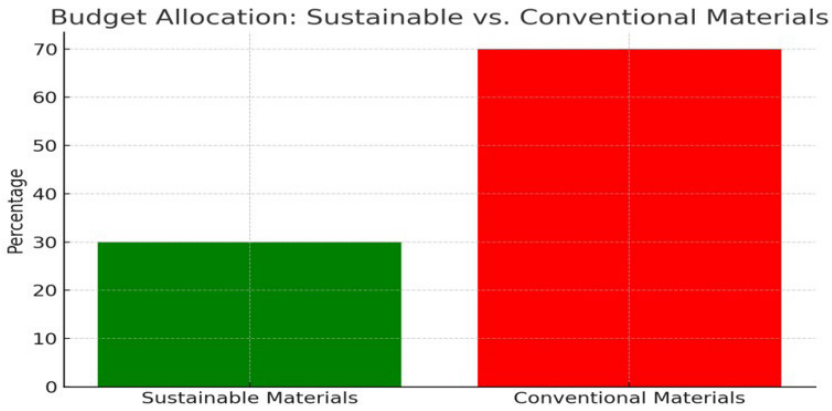

Figure 4: Budget Allocation: Sustainable vs. Conventional Materials

A notable difference is shown in the budget allocation between conventional and sustainable materials in the bar chart. A green bar indicates that about 30% of the money goes to sustainable resources, while a red bar indicates that conventional materials account for the majority at about 70%. This graphic comparison highlights a clear preference for traditional materials, indicating that resources are allotted to sustainability projects at a lower rate. The graph emphasizes the necessity of a more well-rounded strategy to promote increased spending on sustainable materials.

Public-Private Partnership Collaboration Index

The bar chart compares the Public-Private Partnership (PPP) Collaboration Index of Bangladesh with the global average, highlighting a notable gap. Bangladesh's index, represented by an orange bar, stands at approximately 3, while the global average, shown by a purple bar, is significantly higher at around 7. This disparity indicates that Bangladesh's public-private collaboration is less developed compared to the global benchmark, suggesting room for improvement in fostering stronger partnerships between public and private sectors.

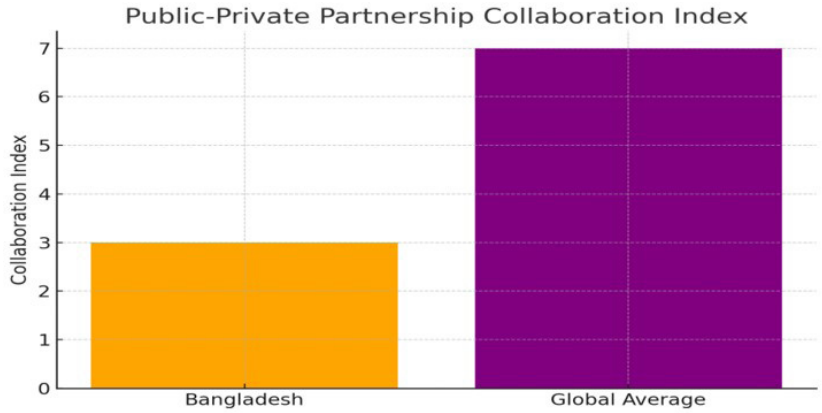

Figure 5: Public-Private Partnership Collaboration Index

Findings

Inadequate GDP Allocation

Bangladesh currently devotes 2-3% of its GDP to climate-related projects, which is not enough to satisfy the nation's growing need for carbon-neutral and sustainable infrastructure.

High Cost of Materials

Since sustainable building materials, such low-carbon cement and cross-laminated lumber are 30–40% more expensive than conventional materials, most developers and contractors cannot afford them.

Restricted Green Financing Option

The construction industry's capacity to adopt environmentally friendly methods is hampered by a large financial deficit, as only 15% of the necessary investments come from green financing programs.

Preference for Budget Efficiency

Short-term cost reductions are frequently the top priority for developers and contractors, who opt for less expensive conventional, non-sustainable materials, which raise carbon emissions and worsens the environment.

Absence of Financial Mechanisms

Investment in environmentally friendly building projects is further hampered by Bangladesh's restricted access to specialized financial instruments such as green bonds or concessional loans.

Insufficient Government Promotions

Bangladesh's lack of tax breaks or subsidies for green building initiatives deters developers from implementing sustainable building techniques, which restricts the broad use of environmentally friendly technologies.

Restricted Public-Private Partnerships

The government and private sector do not work together to promote the development of green infrastructure, which leads to dispersed attempts to scale sustainable building.

Insufficient Long-Term Investment

The shift to carbon-neutral practices is delayed because developers and stakeholders frequently prioritize cutting project costs up front while ignoring the long-term financial and environmental advantages of sustainable building techniques.

Recommendations

Boost Climate-Related Budget

To ensure there is enough money to assist the shift to sustainable building methods and tackle the escalating environmental issues, the government should raise its GDP allotment for green infrastructure projects.

Subsidize Sustainable Materials

To make sustainable building materials like cross-laminated timber and low-carbon cement more affordable for developers, the government should implement tax breaks and subsidies.

Extend Green Financing Mechanisms

To encourage private sector investment and offer financial incentives for the adoption of sustainable building methods, the government should establish and support carbon credit programs, green bonds, and concessional loans.

International Cooperation

To obtain funds, technical support, and information exchange for international projects, Bangladesh should look to form alliances with institutions such as the Asian Development Bank (ADB) and the Green Climate Fund.

Campaigns and Training

Start extensive public awareness campaigns and training initiatives that highlight the long-term financial and ecological advantages of implementing sustainable construction technology for developers, contractors, and the general public.

Administrative Reforms

Put laws into place requiring public infrastructure projects

to employ eco-friendly materials and technologies. To guarantee commitment to sustainable practices, establish sanctions for environmental standard noncompliance.

Assistance for Green Innovation

Promote innovation in the building industry by offering financial aid or other incentives for the study and advancement of sustainable building technologies, such as waste minimization strategies, eco-friendly materials, and energy-efficient systems.

Simplify Green Certification Procedures

To incentivize builders and developers to embrace green construction techniques, streamline and expedite the process of getting green certifications, such as LEED or comparable national standards.

Establish Local Green Construction Expertise

Make educational and training investments to create a workforce with the know-how to plan, build, and maintain environmentally friendly structures, therefore lowering dependency on imported materials and technologies.

Encourage Eco-Friendly Building Practices

Create model buildings and pilot projects to show the viability and benefits of sustainable building, acting as models for upcoming initiatives and promoting a broader adoption of green practices.

Incorporate Green Infrastructure into Urban design

To lower cities' overall carbon footprint and increase their climate change resilience, make sure that urban design incorporates green infrastructure, such as permeable pavements, urban forests, and green roofs.

Collaboration with the Private Sector

To build a more resilient and sustainable construction ecosystem, encourage cooperation between the public and private sectors as well as financial institutions. Public-private partnerships, collaborative ventures, and jointly funded green infrastructure initiatives are a few examples of this.

CONCLUSION

Bangladesh faces many obstacles on its route to carbon-neutral building, such as inadequate funding, restricted access to sustainable materials, a lack of green finance, and a lack of local knowledge of cutting-edge construction technology. However, by taking calculated steps like boosting government funding for climate-related initiatives, encouraging the use of sustainable materials, and developing green finance channels, these challenges can be addressed. The shift to green building methods will also be accelerated by raising public awareness, creating clear legislative frameworks, and encouraging public-private collaborations. Bangladesh can create a strong, sustainable construction industry that not only reduces environmental effect but also meets the nation's rapidly increasing urbanization and housing needs by taking inspiration from successful international models. Bangladesh's building sector can transition to a more sustainable, carbon-neutral future with the help of its foreign partners, industry, and government.

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