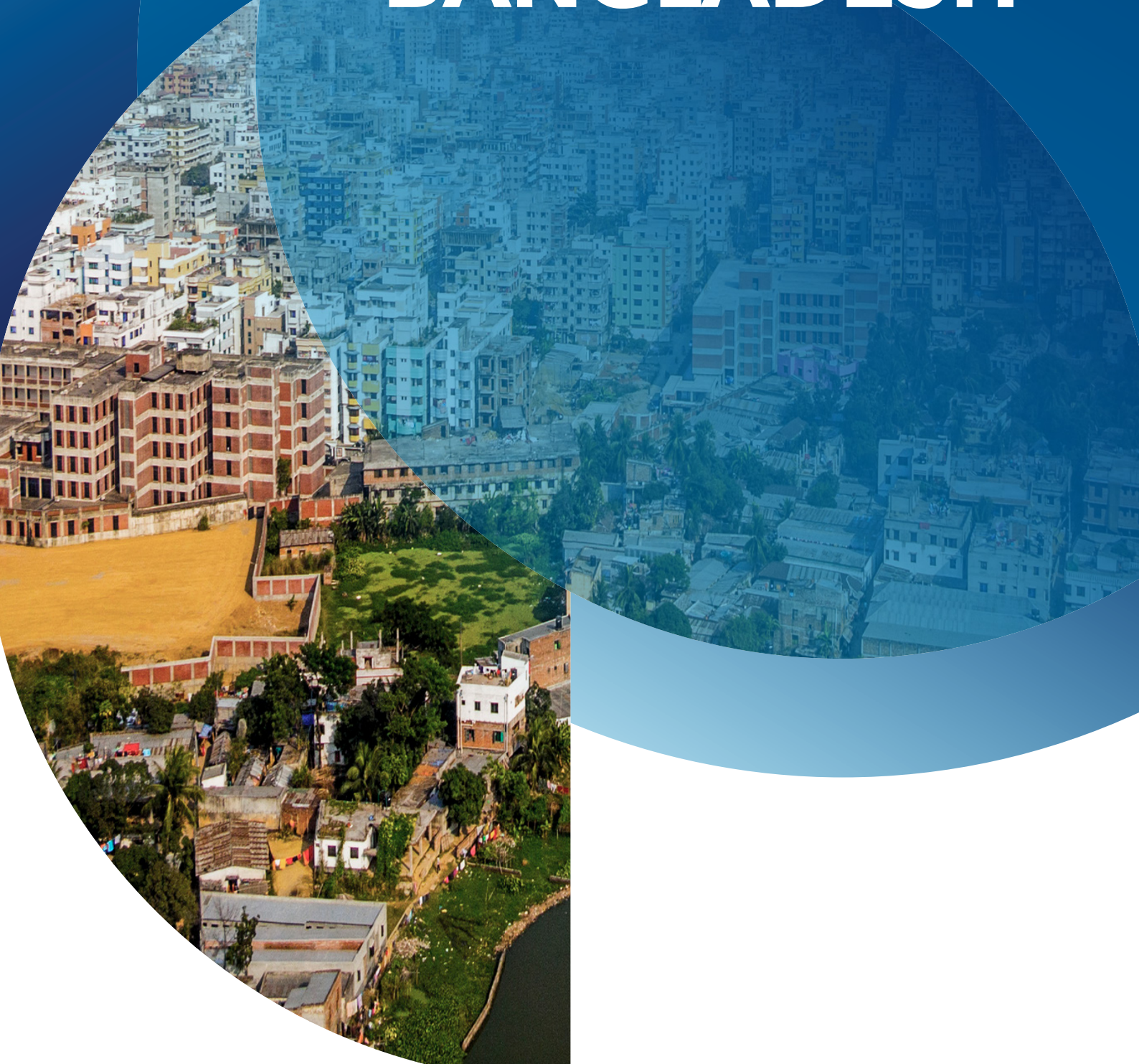


Circularity in the Building Sector

# BANGLADESH



## Acknowledgments

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European Commission, SWITCH-Asia Programme

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# Executive Summary

Bangladesh's construction sector is one of the country's largest consumers of raw materials and a significant source of waste and carbon emissions. Yet it lacks the regulatory frameworks, financing instruments, and skilled workforce needed to shift from a linear to a circular model. This report presents a comprehensive analysis of where that transition stands today and what it will take to accelerate it.

The evidence shows that circular economy practices are already operational in Bangladesh. The reuse of building debris and the scale of informal second-hand material markets indicate that resource efficiency is not merely an aspirational concept, but something that is already happening in parts of the value chain. Project-based experience reinforces this point: pilot initiatives such as nearly Zero Emission Communities (neZECOM) and Healthy Building Research and Innovation Concept (HealBRIC) demonstrate practical pathways for applying circular principles in the built environment.

At the same time, the report finds that systemic barriers remain severe and continue to suppress wider uptake. High upfront costs and limited access to tailored finance make circular options harder to adopt, particularly for smaller firms. Supply chains for recycled materials remain inconsistent, while concerns about the durability and safety of reused or recycled products persist in the absence of reliable standards and certification. These challenges are compounded by weak enforcement of existing building codes and by a workforce of 3.83 million workers (94 per cent of whom operate informally) who are largely untrained in circular construction methods.

These constraints are reinforced by an inadequate policy environment. Bangladesh has no dedicated circular economy strategy. The Bangladesh National Building Code (BNBC 2020) does not include mandatory requirements for material reuse, and financial incentives remain narrowly focused on LEED- and EDGE-related tax benefits that tend to exclude locally reused materials.

To shift circular construction from localised practice to mainstream delivery, the report identifies a few priority actions. The BNBC should be revised to embed circular design principles, including material reuse, design for disassembly, and minimum recycled-content thresholds, and a national Circular Economy Roadmap or Framework should complement this. Financial support needs to go beyond existing green-building incentives, through measures such as tax rebates for developers using recycled or reclaimed materials, low-interest loans channelled through Bangladesh House Building Finance Corporation (BHBFC), and grants for small contractors investing in circular capacity-building. The government can also create predictable demand by enforcing Green Public Procurement across public construction projects, including through the enactment of the draft Sustainable Public Procurement Policy (2023) and the addition of explicit circularity indicators.

In parallel, stronger market governance is needed to increase confidence in secondary materials and improve recovery rates. The report therefore recommends mandating pre-demolition audits for demolition permits above a minimum scale and tasking the Bangladesh Standards and Testing Institution (BSTI) and the Housing and Building Research Institute (HBRI) with developing national quality standards for second-hand and recycled construction materials. Finally, workforce development must be scaled through the Bangladesh Technical Education Board (BTEB), led reform of technical and vocational education and training (TVET) and accredited short-course programmes that reach informal workers. At the same time, universities embed lifecycle assessment and circular design into relevant curricula.

These measures, supported by sustained international partnership through programmes such as SWITCH-Asia, can accelerate Bangladesh's transition to a construction sector that keeps materials in use, minimises waste and builds long-term resilience into the built environment.

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# List of Abbreviations

<b>AAC</b>	Autoclaved Aerated Concrete
<b>BDT</b>	Bangladesh Taka
<b>BEEER</b>	Bangladesh Energy Efficiency and Environmental Rating
<b>BELA</b>	Bangladesh Environmental Lawyers Association
<b>BHBFC</b>	Bangladesh House Building Finance Corporation
<b>BIM</b>	Building Information Modeling
<b>BPDB</b>	Bangladesh Power Development Board
<b>BRI</b>	Building Resilience Index
<b>CBD</b>	Central Business District
<b>CDW</b>	Construction and Demolition Waste
<b>CE</b>	Circular Economy
<b>CLC</b>	Cellular Lightweight Concrete
<b>CSEB</b>	Compressed Stabilized Earth Block
<b>CUET</b>	Chittagong University of Engineering and Technology
<b>DAP</b>	Detailed Area Plan
<b>EDGE</b>	Excellence in Design for Greater Efficiencies
<b>EPD</b>	Environmental Product Declaration
<b>EU</b>	European Union
<b>GDP</b>	Gross Domestic Product
<b>GIZ</b>	Deutsche Gesellschaft für Internationale Zusammenarbeit
<b>GreenARCH</b>	Green Affordable and Resilience Certification for Habitats
<b>HBRI</b>	Housing and Building Research Institute
<b>HealBRIC</b>	Healthy Building Research and Innovation Concept
<b>IFC</b>	International Finance Corporation
<b>LCA</b>	Life Cycle Assessments
<b>LEED</b>	Leadership in Energy and Environmental Design
<b>MoEFCC</b>	Ministry of Environment, Forest and Climate Change
<b>MoHPW</b>	Ministry of Housing and Public Works
<b>Mol</b>	Ministry of Industries
<b>MoPEMR</b>	Ministry of Power, Energy and Mineral Resources

<b>MT</b>	Million Tonnes
<b>neZECOM</b>	nearly Zero Emissions Communities
<b>NGOs</b>	non-governmental organisations
<b>NREL</b>	National Renewable Energy Laboratory
<b>PDB</b>	Power Development Board
<b>PPPs</b>	Public-private partnerships
<b>RMG</b>	Ready-Made Garment
<b>RP</b>	Roller Press
<b>RRR</b>	Round-robin Ranking
<b>SCHB</b>	Sand Cement Hollow Block
<b>SCP</b>	Sustainable Consumption and Production
<b>SDG</b>	Sustainable Development Goal
<b>SREDA</b>	Sustainable And Renewable Energy Development Authority
<b>TB</b>	Thermal Block
<b>USAID</b>	U.S. Agency for International Development
<b>VRM</b>	Vertical Roller Mill

# 1. Introduction & Context

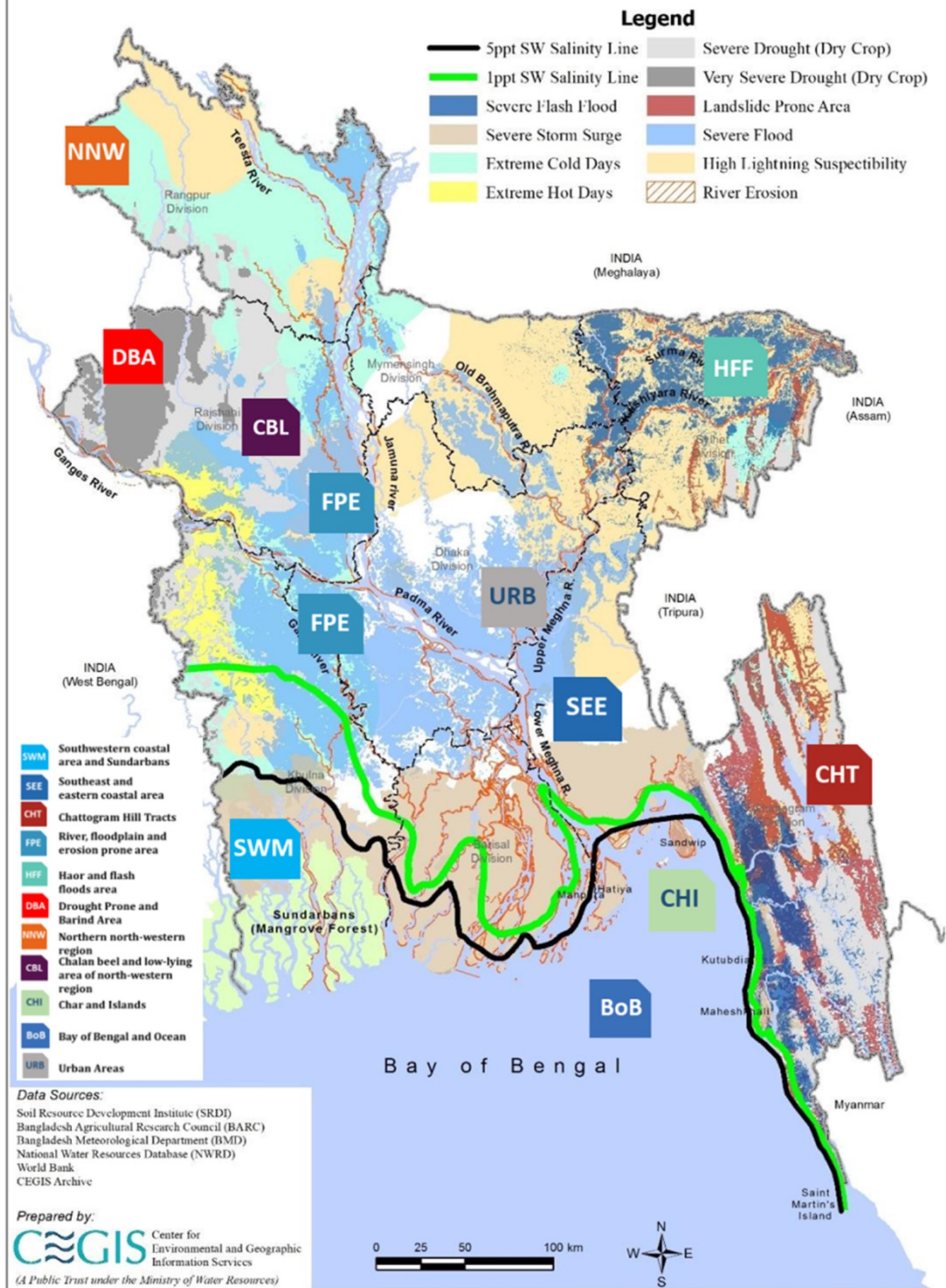
Bangladesh's construction sector is a significant contributor to the national economy, accounting for approximately 8% of the country's GDP<sup>1</sup> and providing employment to an estimated 3.83 million people.<sup>2</sup> The growing demand for housing, urban infrastructure, and rural development drives the sector, shaped in large part by the country's rapid demographic growth and urbanisation. Yet despite its importance, the industry faces persistent challenges, including labour exploitation, low profit margins and the widespread use of substandard materials, that undermine its potential for sustainable growth.

*Table 1 Key Statistics: Bangladesh's Construction Sector at a Glance*

Indicator	Figure
Construction sector share of GDP	~8%
Raw materials used (2019–20)	160 MT
Raw materials imported (2019–20)	~30 MT
Per capita material footprint (2017)	2.51 tonnes (global avg: 12.44 tonnes)
Total population	~170 million
Total construction workers	3.83 million
Share operating informally	94%
Urban population share (2020)	35.7%

These challenges are inseparable from Bangladesh's broader geographic and climatic context. The country's tropical climate, featuring hot, humid summers, mild winters, and intense monsoons, is further complicated by its low elevation, with more than 60% of the landmass lying below six meters above sea level.<sup>3</sup> As a result, Bangladesh is one of the most climate-vulnerable countries globally, ranking 9th in the WorldRiskIndex 2023.<sup>4</sup> It faces a broad spectrum of climate-induced disasters, including floods, sea-level rise, cyclones, droughts and earthquakes. In 2021, the Center for Environmental and Geographic Information Services (CEGIS) created a multi-hazard risk map of Bangladesh that illustrates the spatial distribution of hazards across the country (Figure 1). Between 2000 and 2019, Bangladesh endured 185 extreme weather events, resulting in 11,450 deaths and economic losses totalling USD 3.7 billion.<sup>5</sup> These conditions emphasise the need for resilient infrastructure and climate-adaptive planning in both urban and rural areas, especially as the impacts of climate change intensify.

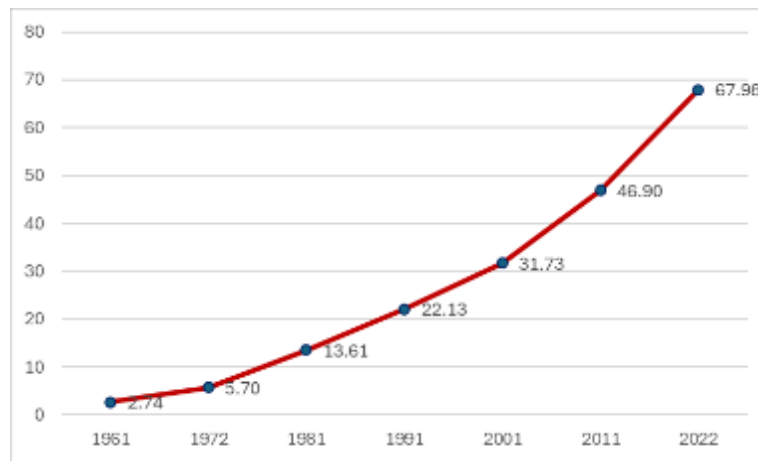
# Climate Stress Areas of Bangladesh



May 2022

Figure 1: Map of climate stress areas in Bangladesh.<sup>6</sup>

Rapid population growth and accelerating urbanisation intensify this pressure. With a population of nearly 170 million, making it the world’s eighth most populous country, Bangladesh has witnessed significant urbanisation and expansion of urban areas, marked by a steady increase in both the urban population and the number of urban centres over recent decades (Figure 2). It was estimated that 35.7% of the population resided in urban areas in 2020.<sup>7</sup> This growth has often occurred in the absence of adequate infrastructure or urban planning, leading to glaring inequalities. Over 1.8 million people currently live in slums and informal settlements<sup>8</sup>, often without secure tenure or access to basic services such as clean water, sanitation and healthcare.



**Figure 2: Growth of urban population in Bangladesh (in millions).<sup>9</sup>**

According to the National Bureau of Statistics, the total number of dwellings in Bangladesh exceeds 35 million, with more than 27 million in rural areas and nearly 8 million in urban areas. Dhaka houses the highest proportion of dwellings at 22 percent of the country’s total.<sup>10</sup> Dhaka, as the capital and economic hub, exemplifies the challenges of rapid, unregulated urbanisation. With over 21 million people in the Greater Dhaka Area, the city ranks as the tenth-largest globally<sup>11</sup> and among the most densely populated. Real estate and construction activity have expanded dramatically, and apartment unit development has increased nearly 600% in the past decade.<sup>12</sup> This boom has often lacked effective planning and infrastructure support, resulting in inefficient land use and overburdened public utilities. Core urban services such as water supply, sanitation, and public transportation lag behind population growth<sup>13,14,15,16</sup>, while informal settlements and overcrowding persist. These issues reinforce the need for more integrated urban planning strategies that accommodate growth while enhancing liveability, equity, and climate resilience.

This trajectory of growth carries significant implications for material demand. With a per capita material footprint of just 2.51 tonnes in 2017,<sup>17</sup> well below the global average of 12.44 tonnes,<sup>18</sup> and total raw material consumption already at 160 MT in 2019–20, the potential for rapid growth in resource use is substantial. The sector’s heavy reliance on imported key materials, such as clinker, steel and stone, further compounds this risk, underscoring the need for greater resource efficiency and stronger local production capacity.

Paradoxically, this construction boom coexists with significant vacancy, revealing systemic inefficiencies in urban planning and demand forecasting. Nearly 59% of public ICT buildings constructed between 2015 and 2021 remained unoccupied,<sup>19</sup> while private commercial high-rises in Dhaka’s central business district (CBD) had nearly 70% vacancy rates post-COVID.<sup>20</sup> In the housing sector, 30% of apartments remained unsold during 2022-23.<sup>21</sup> These figures point to a mismatch between supply and affordability, speculative investment patterns and a lack of reliable data to align markets. Optimising space utilisation through mixed-use developments, adaptive reuse of existing structures, and more accurate demand forecasting is essential to improving urban efficiency and addressing housing inequities.

Demolition trends and workforce structure reinforce these concerns. Many buildings, including historic structures and modernist properties, are demolished due to weak heritage protection, poor maintenance planning, or informal regulatory processes. Renovation and demolition are frequently carried out without proper permits or documentation. The building maintenance cost in Dhaka was calculated at BDT 20,789 million,<sup>22</sup> while the demolition cost amounted to BDT 2,695 million.<sup>23</sup> These figures suggest a worrying trend

in the construction industry, where, in some cases, it is more cost-effective to demolish and rebuild than to invest in maintaining existing structures. This is often due to poor building design, in which maintenance considerations are overlooked during planning and construction. This practice not only incurs higher long-term costs but also contributes to inefficiency and unsustainable development, underscoring the need for more thoughtful design and stronger regulatory enforcement to prioritise sustainable building maintenance over demolition. 94% of the 3.83 million construction workers operate informally, with only 4% involved in recycling or circular activities.<sup>24</sup> Integrating more workers into formal recycling systems, strengthening regulatory frameworks, and promoting sustainable construction practices are critical for enhancing environmental performance and unlocking the potential of a circular economy in Bangladesh's building sector.

Taken together, these conditions: climate vulnerability, rapid and unplanned urbanisation, structural inefficiencies, and a largely informal workforce, underscore both the scale of the challenge and the urgency of systemic reform. By addressing these issues through circular and sustainable practices, the sector can align with national development priorities and global sustainability commitments.

This report contributes to advancing the integration of circular economy principles in the construction sector by providing recommendations for stakeholders. By identifying key challenges and opportunities, it sets the stage for meaningful policy reforms and industry-wide collaboration. The report explores the sector's key challenges, opportunities, and strategic priorities, and identifies high-impact areas for targeted interventions that can yield measurable improvements. It outlines actionable, context-specific recommendations tailored to Bangladesh's socio-economic and environmental landscape, ensuring they are practical and implementable.

Focusing on Sustainable Development Goal 12 (responsible consumption and production), the report assesses the 10R framework (Refuse, Rethink, Reduce, Reuse, Repair, Refurbish, Remanufacture, Repurpose, Recycle and Recover) across six key stages of the building lifecycle: Urban and Rural Planning and Zoning; Planning and Design of Engineered Structures; Material Extraction, Manufacturing, Research and Development; Construction Works, Including Logistics; Maintenance and Facility Management; and Deconstruction and Demolition. These stages serve as critical leverage points for reducing environmental impact and promoting circularity. The report calls for systemic shifts in policy, design, material use and stakeholder collaboration to support sustainable urban development, tackle climate change, and further the goals of the "New Urban Agenda."

## 2. Methodology

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The report employed three key methods for data collection and analysis: literature review, case studies and stakeholder consultations.

### 2.1. Literature review

This process included sourcing data from peer-reviewed journal articles, academic books, conference proceedings, dissertations and databases. Additionally, materials were sourced from government and organisational websites, reports, verified news platforms and social media accounts to ensure a broad and credible foundation. The collected literature was screened to identify key challenges in the construction sector, focusing on resource consumption, environmental impacts such as carbon dioxide (CO<sub>2</sub>) and greenhouse gas (GHG) emissions, and regulatory barriers that may limit the adoption of circular practices and innovation, as described in earlier sections of this report.

### 2.2. Case studies

Contextual insights were gained through the analysis of case studies (Table 2). This involved analysing selected projects to gain contextual insights into the application of circular-economy principles in the building sector. Key project details, challenges, successes and innovations were assessed, and the environmental impact and the replicability of best practices in other contexts were evaluated.

### 2.3. Stakeholder consultations

The method used for the capacities and capabilities assessment involved a series of targeted consultations with key stakeholders across the buildings/construction sector (Table 2). These included policymakers, governmental bodies, non-governmental organisations (NGOs), academia, industry associations, market actors and international development agencies. The approach focused on identifying both strengths and weaknesses within current practices, particularly in relation to sustainable and circular construction.

By incorporating desktop research, case study evaluations and expert consultations, the methodology provided a comprehensive understanding of the current state of circular economy practices in Bangladesh's construction sector. This multi-faceted approach also enabled an overall assessment of the sector's progress and revealed valuable insights to inform future policies. These approaches enabled the identification of key barriers, strengths, and opportunities across the value chain, providing a clearer picture of how circular principles have evolved throughout the projects.

## 3. The Case for Circularity

The global construction industry is a major driver of resource consumption and environmental degradation, responsible for roughly 50% of raw material extraction, 40% of energy use, and over a third of global waste. Its entrenched linear ('take-make-dispose') model depletes virgin resources, fills landfills, and contributes nearly 40% of energy-related CO<sub>2</sub> emissions when embodied carbon is included.

The circular economy (CE) offers a systemic alternative, aiming to close material loops, extend building lifespans, and eliminate waste by design, decoupling economic activity from resource consumption.

### 3.1. The 10R model

A practical tool for implementing CE in construction is the **10R model**, a hierarchy of circularity strategies prioritised by value retention.

- **Highest order** – Refuse, Rethink, Reduce: target resource efficiency at the design stage (e.g., design for disassembly and lean construction)
- **Mid-tier** – Reuse, Repair, Refurbish, Remanufacture, Repurpose: preserve embodied energy, carbon and economic value of existing components
- **Base tier** – Recover, Recycle: close material loops at end-of-life.

The integration of circular principles, supported by policies such as Green Public Procurement (GPP) and Extended Producer Responsibility (EPR), reduces the sector's ecological footprint while also generating economic opportunities. This approach leads to new markets for secondary materials, creates skilled jobs in remanufacturing and deconstruction, and lowers the lifecycle costs of buildings and structures, while minimising their economic externalities, for example, pollution and waste, which are unaccounted for in the current linear paradigm.

<b>R0</b>	<b>Refuse</b>	Make product redundant by abandoning its function or by offering the same function by a radically different (incl. digital) product or service.
<b>R1</b>	<b>Rethink</b>	Make product use more intensive through product-as-a-service, reuse and sharing models or by putting multi-functionality
<b>R2</b>	<b>Reduce</b>	Increase efficiency in product manufacture or use by consuming fewer natural resources and materials.
<b>R3</b>	<b>Reuse</b>	Re-use of a product which is still in good condition and fulfills its original function (and is not waste) for the same purpose for which it was conceived.
<b>R4</b>	<b>Repair</b>	Repair and maintenance of defective product so it can be used with its original function.
<b>R5</b>	<b>Refurbish</b>	Restore and old product and bring it up to date (to specified quality level).
<b>R6</b>	<b>Remanufacture</b>	Use parts of a discarded product in a new product with the same function (and as-new condition).
<b>R7</b>	<b>Repurpose</b>	Use a redundant product or its parts in a new product with different function.
<b>R8</b>	<b>Recycle</b>	Recover materials from waste to be reprocessed into new products, materials or substances whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.
<b>R9</b>	<b>Recover</b>	Recovering energy content of materials in the waste stream.

### 3.2. The 10Rs in a building’s lifecycle: the six “stages” of construction

Integrating circular economy considerations into the construction sector necessitates a systemic transition from the current linear model. Utilising the 10R framework, the principles of circularity can be mapped directly onto the specific phases, or “stages”, of a construction project’s lifecycle. The circularity requirement is incorporated at every stage of the process, from initial macro-level planning decisions to detailed micro-level aspects of material recovery and demolition, with demolition as the final step in closing the circularity loop. Each stage presents distinct opportunities and challenges, yet they are closely interconnected; decisions made in the initial phases significantly influence the circular potential achievable at the conclusion of a building’s life. Construction sector actors must cohesively apply these principles across the six lifecycle stages to fully embrace circularity.



In each stage, there are fundamental considerations for applying circular principles:

Stage	Key CE Strategies
1. Urban/Rural Planning	Refuse, Rethink – prioritise adaptive reuse
2. Planning & Design	Rethink, Reduce – design for longevity and disassembly
3. Materials & Manufacturing	Recycle, Remanufacture, Reduce
4. Construction & Logistics	Reduce, Reuse – minimise on-site waste
5. Maintenance & FM	Repair, Refurbish, Reuse
6. Deconstruction & Demolition	Reuse, Repurpose, Recycle

The transition to a circular system is a complex, incremental process that requires the cooperation of multiple actors across different time horizons. For example, the potential for value recovery during deconstruction is fundamentally determined by design decisions made in the planning phase. The initial and essential action is to commence the process by identifying committed decision-makers and implementers. Implementing a singular circular practice, such as enhanced on-site waste segregation or the design of a project for disassembly, fosters essential knowledge, illustrates economic feasibility, and generates the momentum required for wider systemic adoption. It also demonstrates the need to shift policy frameworks towards circularity and to create the right incentives at different governance levels. A comprehensive shift would also include sanctions for non-circular practices, monitoring to inform adjustments to incentives and sanctioning mechanisms, and making linear models less profitable and feasible at the national level, for example, through taxation and import requirements. This can spur innovation and a shift in market actors’ priorities.

## 4. Analysis of the Sector Value Chain

### 4.1. Resource Consumption

Bangladesh's construction sector is at an early stage of integrating circular economy principles, with low material intensity and limited formal recycling systems. In 2017, the country's per capita material footprint was 2.51 tonnes,<sup>25</sup> significantly below the global average of 12.44 tonnes,<sup>26</sup> reflecting its less industrialised economy. This modest footprint signals a latent potential for rapid growth in material consumption as urbanisation accelerates. In the 2019–2020 period, 160 million tonnes (MT) of raw materials were used, with nearly 30 MT imported. Most construction materials are not directly imported, yet key components, e.g., roughly 90% of clinker,<sup>27</sup> 73% of steel,<sup>28</sup> and 95% of stone<sup>29</sup> used, are reliant on imports. This dependence on foreign sources not only increases the sector's carbon footprint but also makes it vulnerable to global supply chain disruptions, underlining the need to strengthen local production capacities and enhance material efficiency.


The scale of material consumption in Bangladesh's construction sector is heavily skewed toward non-renewable resources. According to various sources,<sup>30</sup> in 2023, the sector consumed approximately 581 MT of materials, dominated by cement (33 MT), sand (480 MT), brick (57 MT), stone (5 MT) and steel (6 MT). In contrast, renewable materials, e.g., timber and bamboo, constituted only 15 MT—just 2.6% of the total. This imbalance emphasises the unsustainable nature of current construction practices and the critical need to incorporate renewable and alternative materials. National-level data on Construction and Demolition Waste (CDW) is scarce. Studies in cities such as Dhaka and Mymensingh indicate informal recycling rates of 4-15%, with combined reuse and recycling rates of up to 57% in certain contexts. Still, the absence of structured data, weak waste segregation, and the informal nature of recycling practices limit the sector's ability to reduce environmental impact and reclaim valuable resources.

Construction materials production (notably bricks, cement and steel) is highly resource-intensive, and brick kilns remain a notable source of fuel- and carbon-intensive emissions within the sector. In addition, the transport of these materials, as well as construction processes and machinery, is resource-intensive. The building and construction sector in Bangladesh is also a major growing energy consumer. Buildings (residential plus commercial/public) account for roughly one-third of national electricity use, driven by urbanisation, rising living standards and expanding demand for cooling, lighting and appliances. This is also because electricity generation in Bangladesh heavily relies on (partly imported) gas, and investment in renewable energy has been low.<sup>31</sup> Schemes for promoting solar energy at the building or household level exist but have not yet reached the mainstream; for example, for more than 20 years, the Grameen Shakti initiative, supported by the public Infrastructure Development Company Limited (IDCOL), has installed 1.8 million solar home systems (SHS), especially in rural areas, benefitting 8 million inhabitants.<sup>32</sup>



Material substitution and reuse, improved kiln and cement efficiency, building-envelope upgrades, passive cooling and appliance standards can simultaneously reduce operational and embodied energy. Targeting both demand-side efficiency in buildings, prioritising material circularity and improving the renewable energy supply at the grid and household level would therefore significantly improve Bangladesh's circular economy outlook.

CDW management remains largely informal and underdeveloped. In 2019-2020, only about 0.8% of CDW<sup>33</sup> was collected through controlled facilities, despite CDW comprising roughly 30% of total solid waste.<sup>34,35</sup> The daily per capita CDW generation in Bangladesh is low - 0.12 kg nationally<sup>36</sup> and 0.22 kg in Dhaka North, compared to the global average of 1.68 kg per person per day reported for 2019-2020.<sup>37</sup> While this suggests relatively low waste generation, it likely reflects underreporting and inefficiencies in formal collection systems. Factory limitations, on-site block production difficulties, and inadequate training among construction professionals further challenge resource consumption. Environmental concerns, such as topsoil loss and deforestation, persist due to the use of traditional materials, including clay-burned bricks. Though some efforts are underway to adopt sustainable alternatives such as recycled aggregates or agricultural waste-based blocks, autoclaved aerated concrete (SCEB), and sand-cement hollow blocks (AAC), the lack of policy support, infrastructure, and capacity continues to hinder meaningful progress.

 To transition toward more sustainable practices, Bangladesh should prioritise sourcing locally renewable and recyclable materials, invest in waste management infrastructure, and promote low-impact building materials throughout construction.


## 4.2. Environmental Impact

The construction and renovation of buildings in Bangladesh currently contribute significantly to greenhouse gas emissions, driven by the construction of new buildings, short average building lifespans, the use of high-emission materials, and the low rate of recycled or reused construction materials. Approximately 95% of these emissions stem from the manufacturing of construction materials - primarily bricks (48.67%) and concrete (35.22%). This reflects the industry's continued reliance on high-carbon materials, rather than moving toward more sustainable options such as mud, bamboo, straw and unburnt bricks. Operational carbon emissions, primarily from energy use in buildings, contribute an additional 29.8 million tCO<sub>2</sub>e annually and are projected to nearly quadruple by 2050. Bangladesh has set ambitious goals of reducing greenhouse gas emissions by 21.85% by 2030 and achieving net-zero emissions by 2050, making the decarbonisation of the building and construction sector critical to achieving national climate targets.<sup>38</sup>

Brick kilns are among the largest individual contributors to carbon emissions, with over 11,000 kilns - both official and unofficial - producing around 33 billion bricks annually and emitting 21 million tonnes of CO<sub>2</sub>. The cement industry has shown some progress by adopting energy-efficient technologies such as vertical roller mills (VRMs) and roller press (RP) systems, which have reduced energy consumption by 25% and pollution by 70% compared to traditional methods.<sup>39</sup> Certification of environmentally friendly practices remains limited. While the Bangladesh Energy Efficiency and Environmental Rating (BEEER) acknowledges international environmental standards, most producers lack certifications beyond ISO 9100.<sup>40</sup> The Green Affordable and Resilience Certification for Habitats (GreenARCH) promotes the use of non-fired brick and recycled materials in construction. The concrete block sector, despite covering over 20% of the market, does not currently meet eco-friendly or non-toxic standards. This regulatory gap underlines the urgent need for stronger enforcement, wider adoption of verified green certifications, and greater transparency in environmental reporting across the supply chain.

Environmental impacts extend beyond carbon emissions, encompassing severe air and water pollution, topsoil erosion and biodiversity loss. Air quality is often poor due to construction and shortcomings in building and energy infrastructure. For example, diesel generators are often used during construction or during peak hours and in summertime, when the electricity supply is irregular. As another key pollution driver in the building and construction sector, waste is often incinerated or dumped in informal landfills. This leads to worsening air quality in cases of uncontrolled burning, while poor waste-disposal practices contaminate soil and water sources, endangering both ecosystems and public health.

Also, cement production and brick kiln incineration contribute significantly to deteriorating air quality. Soil extraction for brick kilns depletes topsoil, threatening agriculture and food security. Rapid urbanisation has intensified land degradation and reduced ecosystem services. Despite the scale of these challenges, progress remains slow due to regulatory shortcomings, inadequate enforcement and limited access to financial incentives.

 A systemic shift toward sustainable construction will require comprehensive policy reforms, enhanced stakeholder coordination, and investment in research and innovation to drive the adoption of low-impact materials and circular economy practices across the sector.

## 4.3. Regulatory Barriers


Despite Bangladesh's commitment to reduce GHG emissions by 21.85% by 2030, the regulatory framework supporting circular economy practices in the construction sector remains fragmented. A fundamental gap underpins this: Bangladesh has yet to adopt a dedicated national circular economy strategy or roadmap. Circular economy considerations are scattered across existing instruments, including the National Industrial Policy, the 3R Policy (2010), the Bangladesh Delta Plan 2100, and the Plastic Industry Development Policy (2023). However, these efforts have not yet consolidated into a coherent framework with sector-specific targets, implementation mechanisms or monitoring provisions. Formulating a Circular Economy Roadmap

aligned with Smart Bangladesh Vision 2041 has been identified as a priority, but remains to be finalised.

Within this policy vacuum, existing instruments offer only partial coverage. Key certifications such as BEEER 2024 (administered by Sustainable and Renewable Energy Development Authority [SREDA]) and the GreenARCH Certification 2024 (introduced by Housing and Building Research Institute [HBRI]) assess dimensions of circularity, including material reuse, embedded carbon and waste management. These are not mandated by national policy, and critical documents such as the Bangladesh National Building Code (BNBC) (2020) lack explicit limitations on embodied carbon or mandatory requirements for the reuse of materials. While the Environmental Conservation Act (1995) and the 3R Policy (2010) promote waste management, they do not align with broader circular economy goals. Social and environmental impact assessments remain limited in scope, and Life Cycle Assessments (LCAs) are not widely practiced. Public procurement does not incorporate circularity-based performance indicators, although the Sustainable Public Procurement Policy (2024) aims to include whole-life cost and end-of-life considerations. Financial incentives are narrow in scope, largely limited to green credit quotas and Leadership in Energy and Environmental Design (LEED) and Excellence in Design for Greater Efficiencies (EDGE)-related tax benefits, without including tax benefits for locally reused or recycled materials.

Regulatory gaps persist at the material and construction process level. Bangladesh Standards and Testing Institution (BSTI) and other bodies maintain standards without embedding circularity principles, and although SREDA has developed energy labelling, no regulations guide low-carbon material production. Material extraction policies are poorly monitored, and informal markets dominate the circulation of recycled materials, with no formal green procurement standards in place. For existing buildings, there is no dedicated authority to oversee renovations, and current policies offer no financial incentives for longevity, reuse, or efficient planning for operation and maintenance. Deconstruction and CDW plans are weakly enforced under BNBC (2020), and no provisions exist for pre-demolition audits. Urban planning frameworks such as the draft Urban and Regional Planning Act (2014) and the Dhaka Detailed Area Plan (DAP 2022–35) recognise ecological issues; however, they lack mechanisms to implement circularity. Coordination between agencies is limited, and adaptive reuse, brownfield redevelopment and biodiversity integration in urban projects are not financially supported or regulated.

Overall, the lack of a comprehensive regulatory framework hampers innovation and sustainability in the construction sector. Weak enforcement, bureaucratic inefficiencies and limited awareness contribute to the slow adoption of circular practices. Without clear national standards for recycled materials, tax incentives for sustainable construction and streamlined green approval processes, stakeholders face obstacles in implementing circular economy initiatives.

 To overcome these challenges, Bangladesh must introduce harmonised policies, enhance enforcement capacity, and create financial and institutional support systems that reward circular design and construction practices. Capacity-building, market-oriented certification systems, and transparent monitoring frameworks are also essential to strengthen the sector's readiness for a circular transition.

#### 4.4. Workforce & Skills Gaps

Bangladesh's construction workforce of 3.83 million<sup>41</sup> is characterised by a deep divide between formal and informal labor, with 94 per cent of workers operating outside regulated employment structures.<sup>42</sup> This informality is accompanied by significant skills gaps that constrain the sector's capacity to adopt sustainable and circular construction practices.

Competency levels vary considerably across the sector. National contractors engaged in the Ready-Made Garment (RMG) industry have accumulated relevant experience through the pursuit of green building certifications: Bangladesh is home to 226 LEED-certified factories, including 89 Platinum and 123 Gold-certified facilities, providing a cadre of contractors familiar with sustainable materials, energy efficiency, and recycled content. Public sector contractors, by contrast, have been slower to integrate green practices, with government procurement frameworks prioritising cost, quality, and safety over sustainability, limiting awareness of certifications such as LEED and EDGE across a broader segment of the industry.

More fundamentally, the majority of construction workers lack formal training in core sustainable practices, including waste management, water conservation, and circular economy principles such as material reuse and recycling. Access to advanced construction technologies, including prefabricated systems, remains limited, particularly for smaller contractors and informal workers.

The education and training system reflects these structural weaknesses. Bangladesh's Technical and Vocational Education and Training (TVET) system, overseen by the Bangladesh Technical Education Board (BTEB), offers construction-related programs at certificate and diploma levels through public, private, and NGO-run institutions. However, TVET enrolment in construction trades remains low relative to the size of the workforce, and curricula have been slow to incorporate sustainability and circular economy content. The majority of skills in the sector are acquired through informal apprenticeships transmitted on the job without formal accreditation, quality control, or alignment with national standards.<sup>43</sup>

Compounding this is the weak institutionalisation of construction standards and enforcement mechanisms. Building codes and sustainability standards exist but are inconsistently applied, particularly in rural areas and in projects procured through informal channels. The absence of mandatory green building requirements in public procurement, combined with limited inspectorate capacity, means that even where standards are defined, compliance is difficult to enforce.

## 5. Case Studies: Evidence of Circularity

Case studies (Table 2) were analysed to gain contextual insights into the application of circular economy principles across the six stages of the construction lifecycle, identifying both stage-specific strategies and cross-stage synergies that enhanced overall outcomes. Cases were selected from diverse regions of Bangladesh to reflect the country's varied environmental and socio-economic conditions. These included urban centres such as Dhaka and Chattogram, where high population density and economic activity shape construction practices, as well as transitional semi-urban areas such as Gazipur and Jhenaidah. Rural and flood-prone northern districts such as Rangpur, Kurigram, and Gaibandha offered insights into agriculture-based contexts, while Mymensingh represented a blend of agriculture and small-scale industry. Rajshahi contributed a dry climate and a rich heritage perspective; coastal regions such as Khulna, Satkhira, and Bagerhat highlighted climate vulnerability; and Sylhet illustrated the unique conditions of tourism-based and indigenous communities.

The selected projects covered a wide range of construction types and scales, including recycled concrete and FaL-G bricks, residential, educational, and industrial buildings, and non-building initiatives such as landscaping and road construction. Both large-scale developments and smaller interventions, such as vernacular homes and building-block manufacturing, were considered to demonstrate the breadth of circular-economy applications. Financial mechanisms such as renovation loans and housing support programmes were also included to capture enabling frameworks.

Each case was examined to understand how the 10R framework was implemented, which principles had the most significant sustainability impact, and how related challenges were addressed. Key project details, challenges, successes, and innovations were assessed using a Triple Bottom Line perspective and a Sustainable Construction Practices Analysis matrix to evaluate economic, social and environmental impacts, extract lessons learned, and assess the replicability of best practices in other contexts. Each case was also evaluated for its innovation, scalability, and contribution to resource conservation and waste reduction. Together, the cases form a comprehensive portfolio of circular construction practices in Bangladesh.

Sixteen preselected cases were systematically evaluated and compared based on their alignment with circular economy goals.<sup>44</sup> Each project was assessed based on the number of lifecycle stages and 10R principles it incorporated; the 9 top cases are briefly described below (with more details in Appendix A), while the analysis extends to all 16 cases.

**Secondhand construction materials market (Dhaka, Bhasantek Road):** An informal network of 200+ traders salvages and refurbishes materials from demolished buildings, then resells them through local retail chains, cutting costs and reducing construction waste. Better deconstruction practices, certification and formalised logistics could improve quality assurance and scale its circular-economy impact.

**SUSBUILD Bangladesh (Mirpur, Dhaka):** The SWITCH-Asia-supported project turns river-dredged soils into lower-carbon masonry units (e.g., CSEB and hollow/thermal blocks), reducing reliance on fired bricks and protecting topsoil. It proved technical viability via testing and MSME partnerships. Scaling depends on market acceptance, standards and consistent quality assurance.

**METI School (Rudrapur, Dinajpur):** Built quickly with community labor using loam, straw, bamboo and rammed earth plus small durability upgrades, the school demonstrates low-embodied, climate-suited vernacular construction. Its success hinged on hands-on training, local ownership and maintenance planning, showing how incremental technical input can upgrade traditional methods.

**Recycling Concrete – HBRI pilot (Mirpur, Dhaka):** HBRI recycled demolition concrete into aggregate and blocks for low-cost housing, paired with passive design and on-site solar/rainwater measures to reduce lifecycle impacts. Wider adoption needs standards, processing infrastructure and incentives to normalise recycled aggregate in formal procurement.

**BRAC University landscaping and renovation (Savar campus):** A campus-wide circular resource plan combined decentralised wastewater treatment, solid waste recycling and rainwater harvesting, supported by costings and an operation and maintenance manual. The case shows how institutions can operate as “circular micro-systems” that reduce wastewater and resource demand through replicable management practices.

**HBRI–Friendship cyclone-resilient homes (coastal districts):** Low-cost homes use locally available materials and strengthened, elevated detailing to withstand wind and flooding, and each unit doubles as an emergency shelter for multiple families. Participatory design and local labor keep costs down while strengthening community resilience and scalability.

**Friendship Centre (Gaibandha):** A flood-resilient, low-carbon public building using local materials and passive cooling, designed for durability and low maintenance in riverine contexts. By combining community training functions with income-generating rentals, it links social resilience with operational sustainability.

**Pani Community Centre (Rajarhat, Kurigram):** A compact, flood-area community facility that maximises passive cooling with an elevated bamboo roof, cross-ventilation, vegetation and a pond, while relying on mostly local and reused materials. It reduces costs and embodied energy while serving as a practical learning site for resilient, circular construction.

**Karupannya Factory (Alam Nagar, Rangpur):** The factory couples passive design (e.g., chimneys, high ceilings, open façades, courtyards and water bodies) with large-scale upcycling of textile and jute waste, reportedly dramatically reducing cooling energy needs while diverting substantial waste. Replication is promising but depends on investment in processing capacity, worker training and robust quality/health and safety systems.

*Table 2. Characteristics of Country Cases Enabling Circular Economy Practices.*

R0: Refuse, R1: Rethink, R2: Reduce, R3: Reuse, R4: Repair, R5: Refurbish, R6: Remanufacture. R7: Repurpose, R8: Recycle, R9: Recover

No.	Project Name	Category	Location	Practices	Stage of Construction [weightage]	R model [weightage]	Total weightage
1	Second-hand Construction Material Market <sup>45</sup>	Material supplier	Bhasantek Bazar, Dhaka and Tribeni, Shaikupa, Jhenaidah	Reusing building debris as alternative construction materials.	Material extraction, manufacturing; and deconstruction and demolition. [2]	R0, R1, R3, R4, R5, R6, R7, R8. [8]	10
2	Vernacular Houses <sup>46</sup>	Residential Buildings	Rajshahi; Mymensingh; Sylhet; Khulna	Build vernacular houses in rural areas using materials with minimal embodied energy.	Planning and Design of engineered structures; material extraction, manufacturing; construction; and maintenance. [4]	R1, R2. [2]	6
3	SUSBUILD Bangladesh <sup>47</sup>	Material research	Mirpur, Dhaka	Evaluate and Utilise alternative building materials and technologies.	Planning and design; materials, R&D; construction; and maintenance. [4]	R0, R1, R2, R6, R7, R8. [6]	10
4	METI School <sup>48</sup>	School Building	Dinajpur	Use of traditional construction techniques by natural resources.	Planning and design of engineered structures; materials; construction; and maintenance. [4]	R1, R2, R3, R7. [4]	8

No.	Project Name	Category	Location	Practices	Stage of Construction [weightage]	R model [weightage]	Total weightage
5	Recycling Concrete <sup>49</sup>	Residential Building	Mirpur, Dhaka	Development of low-cost houses using recycled construction waste.	Planning and design of engineered structures; material extraction, R&D; construction; maintenance; and deconstruction and demolition. [5]	R1, R2, R5, R6, R8. [5]	<b>10</b>
6	HealBRIC Green Apartment <sup>50</sup>	Interior and renovation	Mohammadpur, Dhaka	Minimisation of material waste and promotion of modular design.	Planning and design; R&D; construction; and maintenance. [4]	R1, R2. [2]	<b>6</b>
7	BRAC University Landscaping and Renovation <sup>51</sup>	Campus planning	Savar	Development of reuse and recycle plan based on baseline survey.	Planning and zoning; planning and design of engineered structures; material extraction, R&D; construction; and maintenance, and facility management. [5]	R1, R2, R3, R7, R8. [5]	<b>10</b>
8	Organic Clay Blocks <sup>52</sup>	Material research	Chattragram	Incorporate agricultural waste into clay blocks.	Material extraction, manufacturing, R&D. [1]	R1, R2, R7, R8. [4]	<b>5</b>
9	Grameen Bank Housing Programme <sup>53</sup>	Housing Programme	Various locations in Bangladesh	Supporting low-cost housing with low-interest loans.	Planning and design of engineered structures; manufacturing, R&D; construction; and maintenance, and facility management. [4]	R1, R2. [2]	<b>6</b>
10	Karupannya Factory <sup>54</sup>	Industrial Building	Rangpur	Energy conservation by passive design factory building.	Planning and design of engineered structures; manufacturing; construction; and maintenance, facility management. [4]	R1, R2, R7, R8. [4]	<b>8</b>
11	Pani Community Centre <sup>55</sup>	Cultural Architecture, Community Center	Kurigram	Promote awareness of sustainability and durable building practices.	Planning and design of engineered structures; materials; and construction, and maintenance. [4]	R0, R1, R2, R3. [4]	<b>8</b>
12	Friendship Centre <sup>56</sup>	Architecture, Centre for meetings, training, conferences etc.	Gaibandha	Benchmark for sustainable, climate-resilient architecture in flood-prone regions.	Planning and zoning; planning and design of engineered structures; material extraction, R&D; construction; and maintenance, and facility management. [5]	R0, R1, R2, R3, R8. [5]	<b>10</b>

No.	Project Name	Category	Location	Practices	Stage of Construction [weightage]	R model [weightage]	Total weightage
13	HBRI-Friendship Cyclone Resilient Homes <sup>57</sup>	Shelter Cluster	Satkhira; Bagerhat; Patuakhali.	Cyclone-resilient homes to withstand extreme weather events.	Planning and zoning; planning and design of engineered structures; material extraction, R&D; construction; maintenance; and facility management. [5]	R0, R1, R2, R8. [4]	9
14	Recycled Plastic in Roads <sup>58</sup>	Transport Infrastructure	Gazipur	Focus on conserving the environment in road construction.	Planning and design of engineered structures; material extraction, R&D; and construction work, incl. logistics. [3]	R1, R3, R8. [3]	6
15	FaL-G Bricks/Blocks <sup>59</sup>	Construction Materials	Mirpur, Dhaka	Brick Manufacturing Demonstration and Training Project.	Material extraction, research and development. [1]	R1, R2, R6, R7, R8. [5]	6
16	HBFC House Renovation Loan <sup>60</sup>	Housing Finance	All over Bangladesh	House Renovation Loan.	Planning, design; and construction. [2]	R6, R7. [2]	4

## 5.1. Case Study Analysis: Integration Across the Building Lifecycle

The integration of circular economy practices across the selected case studies at different construction stages is shown in Table 2 (calculation details are in Appendix C). The table highlights both strengths and gaps in sustainable construction efforts. The most widely adopted stages are Material Extraction, Manufacturing and R&D, appearing in 15 of 16 case studies, suggesting potential success for a strong focus on material innovation and sustainable sourcing in Bangladesh. Projects such as *Recycling Concrete*, *Organic Clay Blocks*, and *FaL-G Bricks/Blocks* emphasise research-driven material development, indicating an industry shift toward reducing embodied carbon. This focus on materials does not necessarily translate into robust end-of-life strategies, as evidenced by the limited adoption of *Deconstruction and Demolition* practices, which are present in only two studied cases. This reveals a critical gap in circularity, while materials are being innovated and integrated at the beginning of the lifecycle, their recovery and reuse at the end remain largely unaddressed.

*Planning and Design of Engineered Structures* is integrated into 13 cases, emphasising the importance of incorporating circular principles from the outset. Projects such as METI School, HealBRIC Green Apartment, and Pani Community Centre highlight the role of sustainable architectural design in Minimising energy use and maximising resource efficiency. The relatively low number of cases (three) incorporating *Urban and Rural Planning and Zoning* suggests that broader systemic considerations, such as land use, infrastructure resilience, and policy alignment, are often overlooked. Given the rapid urbanisation in Bangladesh, neglecting planning and zoning can lead to unsustainable urban sprawl, increased construction waste and inefficient infrastructure development. This gap highlights the need for regulatory frameworks that integrate circular principles at the earliest planning stages.

The *Construction Works, Logistics, Maintenance and Facility Management* phases also show considerable integration, appearing in 13 and 11 cases, respectively. Projects such as the *Grameen Bank Housing Programme* and *Karupannya Factory* demonstrate how circular construction practices can extend beyond material sourcing to include efficient logistics, adaptive reuse, and lifecycle maintenance. The relatively lower attention given to long-term maintenance compared to construction suggests that many projects prioritise initial sustainability measures, with little emphasis on long-term operational efficiency. This short-term focus could lead to inefficiencies and increased costs over time, reducing the potential environmental and economic benefits of circular construction.

## 5.2. Case Study Analysis: Application of the 10R Model

The application of the 10R Framework across selected projects is shown in Table 2 (calculation details are in Appendix D). The application of the 10R Framework across construction projects in Bangladesh demonstrates a varied approach to circular economy strategies, yet certain key areas remain underutilised. The most frequently applied principles are *Rethink (R1)* and *Reduce (R2)*, appearing in 15 and 14 projects, respectively, out of 16 studied cases. This indicates a strong emphasis on optimising material use, increasing efficiency, and integrating multi-functional designs, as seen in projects such as *METI School*, *BRAC University Landscaping and Renovation*, and *SUSBUILD Bangladesh*. Despite these efforts, *Refuse (R0)*, which involves avoiding unnecessary material use, is integrated into five projects. This suggests that while efficiency is prioritised, there is still a reliance on material consumption rather than the outright elimination of unsustainable practices.

The integration of *Reuse (R3)*, *Repair (R4)*, and *Refurbish (R5)* is notably low, with *Repair* appearing in only one project and *Refurbish* in just two. The underrepresentation of these strategies highlights a missed opportunity to extend the lifespan of existing materials and reduce the demand for new ones. For example, while projects such as the *Second-hand Construction Material Market* and *Recycling Concrete* engage in material recovery, the focus is more on recycling (*R8*) rather than direct reuse or refurbishment. This approach requires additional energy for material processing and, in some cases, diminishes the environmental benefits of circularity.

On a positive note, *Remanufacture (R6)* and *Repurpose (R7)* are gaining traction, appearing in six and nine projects, respectively. The use of construction waste in new applications, such as *Recycled Plastic in Roads* and *FaL-G Bricks/Blocks*, demonstrates innovative strategies for material repurposing. The absence of *Recover (R9)* across the studied projects indicates a gap in the use of waste-to-energy solutions. Given Bangladesh's pressing need for both sustainable waste management and alternative energy sources, the lack of *Recover* strategies represents an area for policy and technological development.

## 5.3. Key Insights


The case studies examined reveal a wide spectrum of opportunities and challenges associated with integrating circular economy and sustainable construction practices into Bangladesh's built environment. Across different contexts, from informal, traditional systems to structured development projects, key insights emerged that reflect the evolving dynamics of sustainability in the construction sector.

One of the major takeaways is the strong potential for reusing and recycling materials, as demonstrated in the second-hand construction materials market, where bricks, steel, and wooden elements are frequently salvaged and repurposed. Safety concerns, fire risks, and hazardous chemical content limit the reuse of certain materials, such as treated wood, paints and composites, highlighting the need for stricter regulations and improved sorting practices.

Vernacular construction underscores the ecological and cultural value of hyperlocal building practices. These rely on indigenous knowledge and traditional skills, typically passed down through community-based apprenticeship rather than formal training. While environmentally sound and climate-responsive, these practices are constrained by informality, lack of recognition, and a perceived gap in modernity. Scaling them requires a mix of policy support, educational initiatives and incentives to integrate traditional knowledge into national frameworks while blending them with modern safety standards.

Projects such as *SUSBUILD Bangladesh* demonstrate the importance of innovation and targeted engagement. This initiative highlights the promise of sustainable design and the use of local materials, yet faces challenges in market penetration due to limited awareness and resistance from stakeholders who are comfortable with conventional construction. *METI School* case reinforces the need for technical training, public awareness campaigns, and collaborative efforts between the private sector, government, and civil society to mainstream green practices. Recycling concrete offers practical ways to reduce construction waste and lower carbon footprints. Supply chain complexities, lack of standardisation, and the need for stronger infrastructure and technical validation hinder its broader adoption. Investment in R&D, quality certification, and partnerships is crucial for organic clay blocks to scale these innovations.


The HealBRIC Green Apartment model demonstrates how combining energy-efficient design, eco-friendly materials, and stakeholder education can create a replicable framework for urban sustainability. Government policy, consumer awareness, and curriculum reform are vital levers in mainstreaming such models. The Grameen Bank Housing Programme illustrates how scalable solutions can be achieved through financial innovation and community participation, using locally available resources to meet housing needs affordably. The use of recycled plastic in roads presents an inventive solution to plastic waste; however, it raises concerns over microplastic pollution. This highlights the importance of environmental impact assessments and long-term monitoring when introducing new materials into the built environment.

 Key takeaways highlight the value of integrating traditional building techniques into national regulations, especially in Bangladesh's largely informal construction sector. Training and certifying local artisans can formalise the industry, improve quality and preserve skills. A hybrid model that combines vernacular methods with modern safety standards offers a sustainable path forward. Policy incentives and community-based learning are essential to encourage adoption and ensure knowledge transfer. These lessons are relevant to other regions with rich building traditions and similar socio-economic contexts. A coordinated approach linking policy, education and innovation could create scalable, culturally rooted, and sustainable construction models locally and globally. As Bangladesh is particularly vulnerable to climate change impacts, this coordinated approach should also guide climate finance and similar investments to strengthen its built environment. Public and private investors, as well as bilateral or multilateral programmes, should integrate these considerations, not only to anchor investments in local realities, but also to build the sector for long-term resilience and value retention.

#### 5.4. Impact Assessment

The case studies showcase a range of innovative practices that effectively blend sustainability with cultural and community values. The Friendship Centre project exemplifies how traditional construction techniques can be harmonised with contemporary design to achieve both environmental and cultural benefits. The Vernacular Houses project demonstrated the potential of locally sourced, natural materials, such as earth, bamboo and straw, to reduce environmental impact while aligning with the 10R principles of circular construction. The SUSBUILD Bangladesh project introduced forward-thinking models, i.e., product-as-a-service and multi-functionality, which challenge conventional building practices and promote resource efficiency. The HBRI Recycling Concrete Project further underscored the value of reusing construction waste, turning debris into affordable housing solutions. Meanwhile, the METI School project highlighted the importance of community participation and local craftsmanship, fostering skill development and cultural preservation.

Collectively, these projects demonstrate practical approaches to Minimising environmental degradation through material reuse, waste reduction and sustainable construction methods. Their efforts help conserve water, energy and raw materials while reducing greenhouse gas emissions and protecting biodiversity.

 By prioritising lifecycle thinking and ecosystem preservation, these initiatives highlight a replicable model for responsible building. They serve as inspiration for industry stakeholders to embrace sustainable construction practices, supporting broader climate goals and aligning with global frameworks, i.e., the New Urban Agenda.

#### 5.5. Challenges and Opportunities

Using circular practices from the 10R framework in the construction industry is not without its challenges. Table 3 summarises sustainable construction practices across the 16 cases, mapping the key challenges and opportunities for each case. Key barriers include quality control, regulatory constraints, and limited market acceptance, which together restrict the scalability of circular initiatives. At the same time, the cases reveal consistent opportunities for cost reduction, community empowerment, and environmental benefits, providing a strong foundation for broader adoption.

**Table 3. Sustainable Construction Practices Matrix in Bangladesh**

No.	Project Name	Practice	Key Challenges	Opportunities
1	Second-hand Construction Material Market	Reusing building debris as alternative construction materials.	Quality control of second-hand materials; Certification and standardisation; Market acceptance.	Cost reduction; Environmental sustainability; Large market presence.
2	Vernacular Houses	Build vernacular houses in rural areas using materials with minimal embodied energy.	Durability and maintenance; Modernisation pressures; Limited scalability.	Low environmental impact; Preservation of traditional techniques; Cost-effective.
3	SUSBUILD Bangladesh	Evaluate and Utilise alternative building materials and technologies.	Initial research and development costs; Market adoption; Regulatory approvals.	Reduced environmental impact; Cost savings on materials; Preservation of agricultural topsoil.
4	METI School	Use of traditional construction techniques with natural resources.	Skill availability; Modern building standards; Material sourcing.	Sustainable design; Community involvement; Cultural preservation.
5	Recycling Concrete	Development of low-cost houses using recycled construction waste.	Material quality and safety; Public perception; Regulatory compliance.	Waste reduction; Cost-effective housing; Environmental benefits.
6	HealBRIC Green Apartment	Minimisation of material waste and promotion of modular design.	Design complexity; Market acceptance; Initial costs.	Reduced material waste; Flexible and adaptable designs; Improved indoor air quality.
7	BRAC University Landscaping and Renovation	Development of a reuse and recycle plan based on the baseline survey.	Implementation costs; Maintenance and operation; Stakeholder engagement.	Comprehensive waste management; Water conservation; Long-term sustainability.
8	Organic Clay Blocks	Incorporate agricultural waste into clay blocks.	Consistency in material properties; Scaling up production; Market acceptance.	Waste management; Enhanced thermal comfort; Sustainable material innovation.
9	Grameen Bank Housing Programme	Supporting low-cost housing with low-interest loans.	Ensuring repayment, Quality control, and Scalability.	Empowering women; Flood-resistant housing; High repayment rate.
10	Karupannya Factory	Energy conservation by passive design factory building.	Initial design complexity; Adoption of traditional techniques; Maintenance of natural cooling systems.	Energy savings; Reduced environmental impact; Use of recycled materials.
11	Pani Community Centre	Promote awareness of sustainability and durable building practices.	Community engagement; Sustaining interest; Funding for awareness programs.	Local material use; Cost reduction; Enhanced community resilience.
12	Friendship Centre	Benchmark for sustainable, climate-resilient architecture in flood-prone regions.	Use of local materials; Application of passive design; Community-centered functionality.	Integrating renewable energy solutions; Expanding rainwater harvesting; and Implementing smart monitoring systems for resource efficiency.

No.	Project Name	Practice	Key Challenges	Opportunities
13	HBRI-Friendship Cyclone Resilient Homes	Cyclone-resilient homes to withstand extreme weather events.	Localised material sourcing; Integration of resilient building techniques; Funding limitations.	Scaling up production; Broader policy integration; and Community preparedness.
14	Recycled Plastic in Roads	Focus on conserving the environment in road construction.	Technical challenges; Long-term durability and microplastics shedding; Public awareness.	Waste reduction; Cost-effective road construction; Environmental conservation.
15	FaL-G Bricks/Blocks	Brick Manufacturing Demonstration and Training Project.	Quality Control; Market Acceptance; Initial Cost Technical Expertise.	Environmental Sustainability; Market stability.
16	HBFC House Renovation Loan	House Renovation Loan	Quality Control; Market Acceptance; Disbursement Levels.	Environmental Sustainability; Cost Savings; Economic Development.



While the case studies suggest that Bangladesh has made progress in integrating circular economy principles and sustainable construction practices, a systemic shift is not yet evident, and there are clear areas for improvement. Addressing regulatory and market barriers for circular practices is the key issue: this would, for example, enable business cases for deconstruction or the enhancement of material longevity through repair and refurbishment. Leveraging identified opportunities, such as integrating renewable energy solutions and promoting modular, adaptive designs, can accelerate the transition toward a more circular, resource-efficient construction sector in Bangladesh.

## 6. Stakeholder and Market Readiness

The discussions and interviews with key stakeholders highlighted the critical need for policies and partnerships to advance circular-economy principles in Bangladesh's construction sector. Key challenges include resource consumption, environmental impact, limited adoption of sustainable materials and gaps in policy enforcement. Research on sustainable building blocks, alternative materials (e.g., cellular lightweight concrete or CLC), and industrialised construction solutions such as 3D printing and prefabrication shows promise but requires further innovation and local adaptation. The role of EDGE Green Building Certification and government-led rating systems was explored, emphasising the need for financing incentives and awareness campaigns to boost market adoption. The HealBRIC concept and net-zero energy models demonstrate the potential of integrating traditional knowledge with modern technology. Moving forward, multi-stakeholder collaboration, bridging academia, industry and policymakers, is essential. Initiatives such as the SWITCH-Asia project SUSBUILD, knowledge-sharing with the Zero Energy Mass Custom Home (ZEMCH) Network and partnerships with international experts can help shape policies, enhance skills and accelerate Bangladesh's transition towards sustainable, circular construction.

### 6.1. National Contractors

National contractors in Bangladesh have demonstrated varying levels of competency in adopting sustainable construction practices. Some contractors, particularly those in the ready-made garment (RMG) sector, have gained significant experience in green building practices driven by the pursuit of LEED certifications. With 226 LEED-certified factories in the country, including 89 Platinum and 123 Gold-certified facilities, these contractors are increasingly familiar with sustainable materials, techniques and recycled content. Public sector contractors face challenges integrating green construction practices because government projects prioritise quality and safety over sustainability. This gap in awareness and knowledge of green building certifications, such as LEED and EDGE, hinders the broader adoption of sustainable practices in the public sector.

One of the primary challenges faced by national contractors in Bangladesh is the limited familiarity with sustainable materials, such as recycled and reclaimed materials, and the lack of expertise in incorporating them into construction projects. Many contractors lack formal training in essential sustainable practices, including energy efficiency, water conservation and waste management. Knowledge of circular economy principles, such as reducing waste, reusing materials and recycling, remains insufficient. Access to advanced sustainable construction technologies, such as prefabricated construction, is also limited. **To overcome these barriers, targeted capacity-building programs and policy interventions are needed to enhance the competencies of national contractors in Bangladesh.**


 To promote sustainable construction practices, several improvements are necessary. Strengthening policy enforcement and regulatory oversight is essential, as current government initiatives have not sufficiently incentivised sustainability across different building types, particularly in the public sector. Raising awareness and providing education about sustainability will help drive adoption among industry professionals, policymakers and local communities. Investment in research and development is crucial for enhancing sustainable materials, optimising building designs and advancing innovative construction technologies. Contractors should also collaborate with global institutions and sustainability experts to integrate circular-economy principles, prioritise eco-friendly materials, and advocate for regulatory reforms that support circular construction.

### 6.2. Material Suppliers

In Bangladesh, material suppliers play a critical role in the construction sector, particularly in terms of sustainability. The construction steel used in the country predominantly comes from re-rolled materials sourced from nearby shipbreaking yards, with the entire steel production based on 100% recycled materials. This contributes to more environmentally friendly construction practices, reducing the need for new raw materials. The cement industry has seen a growing shift towards CEM-II BM, a type of cement with high

recycled content, including slag from steel production and fly ash from coal-based power plants. This innovation reduces reliance on virgin raw materials and helps lower carbon emissions. Concrete blocks are also produced using locally sourced river sand, further Minimising transportation-related environmental impact. The informal market for recycled and refurbished building materials plays a vital role, especially in cost-conscious projects, by reusing materials to reduce waste and support a circular economy.

Despite these advancements, the construction sector faces significant supply chain challenges that hinder the full adoption of circular practices. A reliance on imported raw materials, particularly for cement and steel production, exposes the sector to global market volatility and shipping delays, leading to project uncertainties and increased costs. Long-distance transportation contributes to higher carbon emissions, offsetting the environmental benefits of local sourcing. Unsustainable sand extraction from riverbeds causes environmental degradation, including river erosion and biodiversity loss. In addition, inadequate infrastructure, particularly in rural areas, and the unregulated informal market further complicate efforts to adopt sustainable practices. Informal markets often rely on low-quality materials that fail to meet safety or sustainability standards, exacerbating the industry's challenges.

 To improve the role of material suppliers in advancing circular practices, several interventions are necessary. Suppliers should embrace circular economy principles by increasing the use of recycled materials, such as recycled steel and concrete, as well as industrial by-products such as slag and fly ash. Cement manufacturers can also adopt alternative binders to reduce their environmental impact. Local sourcing should be prioritised to reduce transportation emissions and Minimise supply chain disruptions. Improvements in logistics and manufacturing processes, such as investing in fuel-efficient transportation and energy-efficient kilns, can also enhance sustainability. The formalisation of the informal supply sector, through certification programs and quality control measures, will help ensure that recycled materials meet performance standards. Long-term innovation in sustainable materials, such as non-fired bricks or composite materials made from recycled waste, is key to reducing reliance on resource-intensive products. Suppliers can also engage in policy dialogues and collaborate with industry bodies to shape guidelines and certifications that support circularity in the construction sector.


### 6.3. Market Trends

Brick remains the primary construction material in Bangladesh, with an estimated 7,859 officially registered brick kilns and an additional 4,000 operating unofficially. These kilns produce around 33 billion burnt bricks annually. In response to environmental concerns, the Ministry of Environment, Forests, and Climate Change (MoEFCC) initiated a policy to shift from clay-fired bricks to non-fired concrete hollow blocks, aiming to achieve 100% adoption in government construction by 2025. This policy has led to the establishment of new non-fired block factories, increasing their availability and offering a more sustainable alternative to traditional brick production.

Consumer preferences are increasingly shaping the construction market in Bangladesh, driven by rising awareness of environmental issues and sustainability. There is a growing demand for buildings that incorporate natural materials, improve indoor air quality, and promote energy efficiency. Consumers are prioritising sustainable, eco-friendly building options that Minimise waste and reduce carbon emissions. This shift in consumer demand has spurred the adoption of green building certifications, such as LEED and EDGE, and greater interest in modular construction and recycled materials. Developers are also focusing on creating buildings that balance aesthetics, health and sustainability to meet these evolving consumer expectations.

Sustainable construction trends in Bangladesh are expanding, with a noticeable increase in the use of recycled and reclaimed materials, such as reclaimed wood, glass and steel. Passive design principles aimed at reducing energy consumption are becoming more popular, alongside the growing interest in net-zero energy buildings that integrate renewable energy sources. Industrialised construction techniques, including prefabrication, are being explored for their potential to reduce waste and enhance efficiency. The growing incorporation of circular economy principles, such as designing buildings for disassembly and promoting material reuse, reflects the sector's broader shift toward sustainability.

## 6.4. Policy Support

 To promote sustainability in Bangladesh's construction sector, a multi-faceted policy approach is essential. The government can strengthen regulatory enforcement by establishing and enforcing regulations that incentivise sustainable practices, such as offering tax benefits for circular economy initiatives and streamlining approval processes for green building projects. Developing national standards for second-hand and recycled construction materials can help ensure quality control and market acceptance, thus promoting wider adoption of sustainable materials. Capacity-building programs for industry professionals, policymakers and local communities can raise awareness and deepen understanding of the benefits of sustainable construction. Improved financing mechanisms, including low-interest loans and grants, would further support sustainable building initiatives.

Good practices and policies of other countries also play a crucial role in shaping Bangladesh's sustainable construction landscape. For example, the EU encourages the reuse of second-hand construction materials under its Circular Economy Action Plan and Waste Framework Directive. The EU's regulations prioritise the reuse, recycling and energy recovery of waste materials while monitoring standards to ensure environmental and worker safety. Certifications such as CE marking and Environmental Product Declarations (EPDs) verify the safety and sustainability of reused materials, aligning with EU sustainability goals.

Several EU programs support sustainable construction in Bangladesh, including the Switch-Asia Program, which promotes sustainable consumption and production, and the EcoBuild Program, which focuses on material innovation and policy updates. These initiatives, alongside Bangladesh's government incentives, for example, green bonds, low-interest loans, and tax incentives, create a collaborative environment for the adoption of circular economy principles. Public-private partnerships can also foster research, pilot projects and technology adoption, further driving the transition toward a sustainable and circular construction sector.


## 6.5. Innovation Potential


Emerging technologies are playing an important role in advancing circular construction practices and improving resource efficiency and sustainability. Modular construction, by prefabricating building components in factories, minimises material waste and allows for easy disassembly and reuse.

Already, some players in the market are offering prefabricated structures, such as container/modular homes or rapid-deployment structures. These firms supply factory-made modules, often steel, for residences, offices, factories and shelters, reducing on-site waste, shortening schedules and enabling easier disassembly and reuse compared with conventional brick construction. For example, the Dhaka-based engineering firm SRD has completed several large-scale new buildings and refurbishing projects using prefabricated panels, including steel sheets.<sup>61</sup>

Building information modelling (BIM) further enhances circularity by enabling data-driven design that reduces waste and improves material reuse. A recent review documents the first experiences with barriers, including the lack of demand and skilled personnel, and software costs.<sup>62</sup> In other countries, BIM has promoted circularity by enabling the integration of lifecycle data useful for circularity (e.g., planned disassembly and material libraries).

The use of recycled materials, such as reclaimed wood, steel and plastics, helps lower demand for virgin resources while diverting waste from landfills. The HBRI pilot in Mirpur, which repurposed concrete from demolition, is one example; second-hand construction materials markets in Dhaka also demonstrate the potential.

 At the same time, regarding innovative approaches for recycling, it would be important to develop low-barrier standardisation. This would also require investment in these systems, as well as buy-in from producers/recyclers and builders, who have been partly reluctant to do so. Using second-hand materials is generally seen as subpar, when in fact this is oftentimes not the case, or processing steps can be taken to assure their quality, for example, regarding recycled steel. It would be important to bring stakeholders together to define the necessary formalisation steps, including quality control and, potentially, certification schemes, to assure quality and strengthen demand. Public investment projects could require recycling quotas or the use of recyclable materials to initiate demand.

 The adoption of biodegradable materials, including bioplastics and biocomposites, can offer promising potential to reduce environmental impact in the construction sector; as this is highly local, it would be important to explore material alternatives in research projects and confirm them in real-world pilot studies. Low-tech solutions must also include construction that reflects local needs. This includes elevated structures, flood-resistant materials and innovative ventilation systems, as well as green roofs and shaded facades; these need to be further explored, monitored, and studied to demonstrate their positive impact and unlock their potential.

Advanced technologies such as 3D printing can be used to create complex structures from locally sourced materials, significantly reducing waste and transportation needs. These innovations promote a resource-efficient, circular economy, reducing the construction industry's environmental footprint.

Digital tools are transforming the sector by enabling data-driven decision-making and optimising resource use. BIM enhances planning accuracy, while energy efficiency software identifies operational improvements. Digital platforms for sustainable material management and waste tracking further streamline processes, ensuring that materials are responsibly sourced, reused and recycled. By integrating these approaches, the construction industry can advance toward greater sustainability and circularity.

# 7. Integrated Policy Recommendations

The following recommendations consolidate policy and action guidance from across this report into a single, structured framework, organised by actor.

## 7.1. For Government (Regulatory and Fiscal)

Government actors at national and sub-national levels bear primary responsibility for creating the enabling environment in which circular construction can scale. The following measures are recommended.

- Revise the Bangladesh National Building Code (BNBC) to embed circular economy principles: mandatory provisions for material reuse, design for disassembly, adaptive reuse of structures, and minimum recycled-content thresholds for public buildings. The BNBC (2020) currently lacks explicit limitations on embodied carbon or mandatory material reuse requirements.
- Mandate pre-demolition audits for demolition permits above a minimum scale, requiring developers to assess and document the reuse or recycling potential of materials before demolition begins. Such audits are currently absent from BNBC provisions and CDW enforcement is weak.
- Enforce Green Public Procurement (GPP) across government construction projects. Procurement frameworks must move beyond cost, quality and safety criteria to explicitly reward sustainability certifications (LEED, EDGE, GreenARCH) and recycled-content specifications. State-led projects should set the standard for the private sector.
- Introduce financial instruments to reduce the cost barrier to circular adoption: tax rebates for developers using certified recycled or reclaimed materials; low-interest loans and green bonds channelled through the Bangladesh House Building Finance Corporation (BHBFC); and grants for small contractors undertaking capacity-building in sustainable construction.
- Streamline approval processes for green building projects. Current bureaucratic inefficiencies and weak enforcement are slowing the adoption of circular practices; a dedicated, fast-track pathway should be established within relevant government bodies.
- Develop national quality standards for second-hand and recycled construction materials to enable certification and market acceptance. Without such standards, informal material markets cannot scale into reliable supply chains.
- Strengthen coordination between SREDA, HBRI, BSTI, and BHBFC to prevent regulatory fragmentation and ensure that circular economy objectives are embedded across sectoral policies.

## 7.2. For the Private Sector (Industry and Finance)

Industry actors, material suppliers, developers and financial institutions are critical for translating policy intent into market practice. The following actions are recommended.

- Develop accessible certification schemes for second-hand and recycled construction materials. Low-barrier certification (analogous to CE marking in the EU) would assure quality, strengthen buyer confidence, and formalise the already active second-hand markets in Dhaka and other cities. Industry associations should lead the design of these schemes in partnership with HBRI and BTEB.
- Scale investment in prefabrication and industrialised construction. Firms such as Dhaka-based SRD have demonstrated the viability of prefabricated panels for large-scale projects. Wider adoption reduces on-site waste, shortens construction schedules, and enables disassembly and reuse. Financial institutions should establish dedicated credit lines for the adoption of prefabrication technology.
- Invest in 3D printing technologies that use locally sourced materials to reduce waste and enable complex structures, alongside digital platforms for sustainable material management and waste tracking.

- Invest in Building Information Modelling (BIM) adoption, including lifecycle data integration (e.g., planned disassembly and material libraries). Industry should collectively address identified barriers: lack of demand signalling, shortage of skilled BIM personnel and software costs.
- Explore and pilot product-as-a-service (PaaS) models for construction components, in which manufacturers retain ownership of high-value materials (such as structural steel and modular panels) and recover them at the end of building life. This shifts incentives from volume sales toward durability and circularity.
- Integrate renewable energy into construction material production, e.g., solar-powered kilns, biomass-fuelled manufacturing, to significantly reduce embodied carbon across the supply chain.
- Promote rapidly renewable and local material alternatives such as bamboo, lime and agricultural-waste-based products as a sustainable resource base suited to the regional context, through dedicated market development and investment in supply chains.
- Contractors with LEED and EDGE experience, particularly those from the RMG sector, should formalise and transfer their sustainability knowledge to public- and informal-sector counterparts through structured peer-learning and mentoring programmes.
- Financial institutions and development finance organisations (including IFC and BHBFC) should expand their green finance product offerings, including sustainability-linked loans and green bonds, to support developers and SMEs in adopting circular technologies.

### 7.3. For Academia and Training Institutions

A systemic transition to circular construction requires a generation of professionals educated in its principles. The following actions are recommended for universities, TVET institutions, and training bodies.

- Embed circular economy principles, sustainable material science, lifecycle assessment (LCA) and design-for-disassembly into undergraduate and postgraduate curricula in architecture, civil engineering and urban planning. Universities, including CUET and Dhaka-based institutions, should lead curriculum reform in coordination with BTEB.
- Update TVET programmes to include practical training in deconstruction techniques, waste sorting, handling recycled materials and sustainable construction methods. Enrolment in construction-related TVET programmes remains low relative to the workforce size; targeted outreach and incentives are needed to increase uptake.
- Train artisans and informal construction workers in deconstruction, repair and refurbishment skills. Given that 94% of the workforce operates informally, accredited short-course programmes delivered through NGOs, construction associations, and local government are the most effective channel.
- Establish research centres or units focused on sustainable and circular construction, with a mandate to investigate locally appropriate materials (e.g., bamboo, lime, agricultural-waste-based bricks and bioplastics), monitor pilot projects, and produce evidence for policy development.
- Raise public awareness and provide education about sustainability and circular construction among industry professionals, policymakers and local communities to drive broader adoption across building types.
- Facilitate knowledge exchange with international institutions, including the Zero Energy Mass Custom Home (ZEMCH) Network and SWITCH-Asia SUSBUILD partners, to import and contextualise global best practice.

## 7.4. For International Partners (EU and Development Organisations)

International partners, particularly the EU through the SWITCH-Asia Programme, play an important catalytic role in de-risking innovation, transferring knowledge and shaping the policy environment. The following actions are recommended.

- Support and scale pilot projects that demonstrate circular solutions in the Bangladesh context. The neZECOM (Nearly Zero Emission Communities) and HealBRIC (Healthy Building Research and Innovation Concept) projects provide replicable models; continued and expanded funding for these initiatives is a high-priority investment.
- Facilitate structured knowledge transfer on Environmental Product Declarations (EPDs) and LCA methodologies. EU experience with EPD systems under the Construction Products Regulation offers directly transferable learning that would support Bangladesh's development of national material certification frameworks.
- Promote circular procurement standards in EU-funded infrastructure and construction projects in Bangladesh, using these as demonstration cases for GPP and setting a market signal for local suppliers.
- Support the development of public-private partnerships (PPPs) linking Bangladeshi construction firms, academic institutions and EU counterparts for joint research, technology transfer and pilot project implementation.
- Encourage the adoption and adaptation of the EU Circular Economy Action Plan and the principles of the Waste Framework Directive within Bangladesh's national policy process, particularly regarding material reuse hierarchies and producer responsibility.

## 8. Conclusion

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The evidence assembled in this report confirms that circular economy practices are both feasible and already operational in Bangladesh's construction sector. Initiatives such as HealBRIC, the HBRI Mirpur pilot, and the active second-hand material markets in Dhaka demonstrate that reuse, recycling and resource efficiency are not aspirational concepts but present realities. Bangladesh's 226 LEED-certified RMG factories further show that sustainability at an industrial scale is achievable. The 10R framework provides a coherent structure for scaling these practices across the value chain, from planning and design through to deconstruction and recovery.

Yet a systemic shift has not occurred. Initiatives remain localised, supply chains inconsistent, regulatory frameworks fragmented, and the informal workforce (94% of 3.83 million workers) largely untrained in circular methods. High upfront costs deter adoption among small firms and individual builders, and sustainable housing solutions must be made accessible to low-income communities if the transition is to be equitable. Stakeholder consultations reinforced the need for policy alignment, capacity building and structured collaboration: integrating traditional knowledge, for example, bamboo, lime and vernacular construction, with modern techniques such as prefabrication, BIM and renewable-energy-powered material production.

Closing this gap requires sequencing, commitment and coordination across different actor groups. Governments must revise codes, mandate audits and create financial incentives. The private sector must invest in certification, prefabrication and circular business models. Academia and training institutions must equip the next generation and retrain the existing workforce. International partners must sustain the pilot projects and knowledge-transfer mechanisms that accelerate learning. Bangladesh's climate vulnerability (ranking 9th on the World Risk Index 2023) makes this transition not only an environmental imperative but a development one. A construction sector that keeps materials in use, minimises waste, and builds resilience into every structure it creates is essential for the country's long-term sustainable development.

# Appendices

## Appendix A. Further details on the nine top country cases.

### Secondhand construction materials market

The secondhand construction materials market, most visibly along Bhasantek Road in Dhaka, hosts over 200 traders who salvage, refurbish and retail materials from demolished buildings: e.g., bricks, window grills, timber and steel doors, corrugated sheets and shop shutters. Traders sometimes purchase entire demolished structures, disassemble them, process items on-site (e.g., cleaning and minor repairs), and redistribute goods across retail networks; recycled shipping materials are also reused. The informal market reduces waste, lowers construction costs and generates local employment, but faces quality assurance gaps and limited regulatory recognition. Strengthening deconstruction protocols, introducing certification for reclaimed items, and formalising logistics could yield greater environmental benefits and integrate this existing circular-economy practice into national waste and construction policies.

### SUSBUILD Bangladesh, Mirpur, Dhaka

SUSBUILD, a SWITCHAsia supported initiative, developed alternative walling materials from river-dredged soils and limited cement, producing Compressed Stabilised Earth Blocks (CSEB), sand-cement hollow blocks, and thermal blocks. The project repurposes dredged sediments (protecting agricultural topsoil), lowers emissions by avoiding fired bricks and produces cost-competitive units for urban housing. Outputs include thousands of hollow and thermal blocks, validated through material testing and MSME partnerships for localised production. The intervention applies 10R strategies (e.g., Rethink, Reduce, Remanufacture and Recycle) and emphasises supply chain development, quality control and community engagement. Challenges remain around market acceptance, regulatory integration and consistent quality assurance. Still, SUSBUILD shows a credible pathway to decarbonise masonry supply chains and scale lower embodied alternatives in dense urban contexts.

### METI School, Rudrapur, Dinajpur

METI School showcases rapid, community-centred construction using traditional materials combined with improved techniques. Completed within months, the project used loam, straw, bamboo and rammed earth approaches adapted by visiting architects and local artisans. Design features include bamboo latticed window panels for daylight control, a bamboo stick roof frame and rammed straw/mud lower walls; nylon and other simple interventions improved durability and functionality. The model delivered low embodied energy, job and skills transfer, and culturally resonant architecture suited to the local climate. Critical success factors were hands-on training, community ownership and maintenance planning, reinforcing that vernacular methods, when combined with incremental technical input, offer scalable, low-carbon building solutions for rural Bangladesh.

### Recycling Concrete (Mirpur, Dhaka), HBRI pilot for low-cost housing

The HBRI-led Mirpur pilot (implemented 2007-2008) converted demolition concrete (notably from the Rangs Bhaban demolition) into crushed aggregate and remanufactured blocks for low-cost housing. The project integrated recycled concrete into the material chain while pairing it with passive design measures (such as south-facing layouts and natural ventilation), and onsite solar and rainwater harvesting to reduce lifecycle impacts. Key enablers included rigorous material testing regimes, advocacy to overcome public scepticism, and design adaptations to ensure structural safety. Benefits observed: reduced landfill loads, lower embodied carbon versus new concrete production, cost savings and local job creation in processing and construction. Scaling requires standards for recycled concrete aggregate quality, dedicated processing infrastructure and incentives to incorporate reclaimed materials into formal procurement.

## **BRAC University Landscaping and Renovation, Savar Residential Campus**

BRAC University's Savar campus implemented an integrated reuse and recycling plan founded on a baseline assessment of solid waste, black/grey water and rainwater flows. Consultants designed decentralised wastewater treatment, a campus solid waste recycling stream and a rainwater harvesting system, and produced construction estimates plus an operations and maintenance manual. The approach closes resource loops: treated wastewater and harvested rainwater supply nonpotable uses; recycled solids are redirected to campus services. Capacity building and operational documentation were central, enabling sustained performance post-construction. The case illustrates how institutional campuses can function as circular microsystems, demonstrating measurable reductions in discharge loads and resource demand and offering a replicable model for other educational or institutional facilities in Bangladesh.

## **HBRI–Friendship Cyclone Resilient Homes, Multiple coastal sites**

This partnership delivers low-cost, cyclone-resistant dwellings across several coastal districts, combining Housing and Building Research Institute (HBRI) technical inputs with Friendship's community outreach. Homes use locally available materials and reinforced details, elevated plinths, strengthened frames and tied connections to withstand extreme winds and flooding. Distinctively, each house doubles as an emergency shelter able to accommodate multiple households, integrating everyday use with disaster response. The scheme emphasises participatory design, incremental construction and local labour, keeping costs low while building adaptive capacity. By aligning resilience with affordability and utilising local supply chains, the project reduces post-disaster recovery burdens and demonstrates a scalable practice for mainstreaming disaster-resilient housing in coastal Bangladesh.

## **Friendship Centre, Gaibandha**

The Friendship Centre is framed as a benchmark for climate-resilient, low-carbon architecture serving riverine island (char) communities. Inspired by regional monastic forms, the centre uses locally available materials and passive cooling strategies to reduce embodied and operational energy. Raised construction addresses flood risk while simple, robust detailing minimises maintenance needs. Programme-wise, it combines training facilities with income-generating rental space for meetings and conferences, supporting operational sustainability. The design prioritises social resilience, facilitates community capacity building for vulnerable populations, and demonstrates how vernacular typologies and local materials can be adapted to produce a replicable model for low-maintenance, climate-responsive public buildings in dynamic fluvial environments.

## **Pani Community Centre, Rajarhat, Kurigram**

The Pani Community Centre is a compact, climate-sensitive community building that demonstrates material circularity and local resource use in a flood-prone district. Two volumes sit beneath an elevated bamboo roof to reduce heat gain; cross-ventilation, surrounding vegetation, and an adjacent pond enhance passive cooling. Construction prioritised locally sourced materials within a 15-mile radius (e.g., mango wood, reused steel, bamboo and hand-shaped brick) and an innovative brick bond reduced timber demand by combining bamboo with thin concrete floors. The project explicitly targets cost reduction, local skill development and low embodied energy through the reuse and repurposing of materials, while serving as an applied learning site for resilient building techniques and the activation of the local supply chain in rural Bangladesh.

## **Karupannya Factory, Alam Nagar, Rangpur**

The factory integrates passive climate design with large-scale material recycling to create a low-energy, circular manufacturing facility. The factory employs vernacular cooling strategies (e.g., high 12-foot ceilings, rooftop chimneys, open southern façades, landscaped courtyards and adjacent water bodies) to maintain indoor temperatures 4-6°C below ambient without mechanical cooling, reducing electricity consumption by an estimated 80%. Material circularity is embedded in operations: the facility processes roughly 3,000 tonnes of cotton waste, 1,200 tonnes of garment offcuts and 4,500 tonnes of jute fibre annually into Shataranji products, diverting substantial waste from landfills and lowering upstream resource demand. Construction used locally sourced ordinary brick and natural finishes; construction byproducts were repurposed onsite. The project demonstrates that combining passive design, local materials and industrial-scale reuse can deliver notable energy and waste savings. However, replication requires investment in processing infrastructure and worker training to maintain product quality and health and safety standards.

## Appendix B. Characteristics of Country Cases Enabling Circular Economy Practices.

No.	Project	Practice	Location	Time frame*	Organisational setup*	Category	Details/highlights	Stage of Construction [weightage]	R model [weightage]	Total weightage
1	<b>Second-hand Construction Material Market</b>	Reusing building debris as alternative construction materials and purchasing second-hand building materials to reduce construction costs and promote sustainable practices.	Bhasantek Bazar, Dhaka Cantonment, Dhaka; and Tribeni, Shaikku-pa, Jhenaidah	A common practice of daily operations		Material supplier	The largest second-hand construction materials market in the country is situated along Bhasantek Road, where over 200 traders operate. They refurbish and sell items, e.g., window grills, wooden and steel doors, corrugated iron sheets, and shop shutters. After purchasing entire demolished buildings, traders distribute materials to various retailers. Recycled shipping materials are also processed for reuse. At the same time, on-site cleaning and repairs prepare bricks, metal items, and iron plates for resale, supporting a robust trade in repurposed building materials.	Material extraction, manufacturing; and deconstruction and demolition. [2]	R0, R1, R3, R4, R5, R6, R7, R8. [8]	10
2	<b>Vernacular Houses</b>	Build vernacular houses in rural areas using materials with minimal or no embodied energy, thereby avoiding the need for industrial processing.	Alponagram in Rajshahi; Meduary, Bhaluka village in Mymensingh; Khasia Palli Nakshiorpuryi, Jaflong in Sylhet; Botiaghata in Khulna	A common practice of daily operations		Residential Buildings	In Alponagram, Rajshahi, a 20-year-old house made of mud, bamboo, and tin, has required only minor repairs. A 65-year-old house in Bhaluka Village, Mymensingh, built with mud, brick, tin, and wood, has undergone modifications due to its age. In Khasia Palli, Jaflong, Sylhet, a 100-year-old tribal house originally made of wood, timber, and bamboo has had its roof replaced with tin and added precast columns for support. A 30-year-old house in Botiaghata, Khulna, is constructed of mud, unburnt brick, nipa palm, and tin.	Planning and Design of engineered structures; material extraction, manufacturing; construction; and maintenance. [4]	R1, R2. [2]	6

No.	Project	Practice	Location	Time frame*	Organisational setup*	Category	Details/highlights	Stage of Construction [weightage]	R model [weightage]	Total weightage
3	<b>SUSBUILD Bangladesh</b>	Evaluate and Utilise alternative building materials and technologies as effective walling options.	Mirpur, Dhaka	Jan 2016- June 2019	Oxfam; Bangladesh Environmental Lawyers Association (BELA); Housing and Building Research Institute (HBRI); Jagorani Chakra Foundation (JCF).	Material research	The researcher uses river-dredged soil and cement to create alternative materials, e.g., Compressed Stabilized Earth Block (CSEB), Sand Cement Hollow Block, and Thermal Block, all of which do not emit harmful gases during production. Although a small amount of cement is used, it has a significantly lower environmental impact compared to firebricks. Additionally, river-dredged soil preserves valuable agricultural topsoil, and using locally sourced raw materials makes these alternatives more affordable than conventional firebricks.	Planning and design; materials, R&D; construction; and maintenance. [4]	R0, R1, R2, R6, R7, R8. [6]	10
4	<b>METI School</b>	Use of traditional construction techniques by natural resources, such as mud, Bamboo, Coconut coir, and straw	Rudrapur, Dinajpur	6 months (September to December 2005, March - April 2006)	DipShikha NGO	School Building	The Modern Education and Training Institute (METI) School was built in just four months by foreign architects, local artisans, pupils, and teachers. The project emphasised the use of local materials and craftsmanship with enhanced techniques. Constructed from loam, straw, bamboo, and nylon, the sustainable design features bamboo window panels that control light. The roof is supported by a frame of bamboo sticks arranged vertically and diagonally. The lower part of the school is made from rammed straw and mud, with classrooms connected by caves through holes in the walls.	Planning and design of engineered structures; materials; construction; and maintenance. [4]	R1, R2, R3, R7. [4]	8

No.	Project	Practice	Location	Time frame*	Organisational setup*	Category	Details/highlights	Stage of Construction [weightage]	R model [weightage]	Total weightage
5	<b>Recycling Concrete</b>	Development of low-cost houses using recycled construction waste (demolished concrete buildings)	Mirpur, Dhaka	2007-2008	Housing and Building Research Institute (HBRI)	Residential Building	This project demonstrates the potential of reusing materials from demolished buildings as an effective strategy for sustainable development. Given that these materials, often containing concrete, are non-biodegradable and can cause significant environmental harm, their proper treatment and disposal at the end of their lifecycle are critical. By adopting appropriate measures and efficiently managing these materials, it is possible to Minimise waste, reduce carbon emissions, lessen the burden on landfills, lower costs, and decrease the embodied energy required for constructing new structures.	Planning and design of engineered structures; material extraction, R&D; construction; maintenance; and deconstruction and demolition. [5]	R1, R2, R5, R6, R8. [5]	10
6	<b>HealBRIC Green Apartment</b>	Minimisation of material waste and promotion of modular design	Flat no 7-C, Malancha, Mohammadpur, Dhaka	Jan 2017-June 2019	Healthy Building Research and Innovation Concept (HealBRIC)	Interior and renovation	This project prioritised Minimising material waste by optimising the use of bricks and tiles and aligning interior walls with tile layouts. Eco wood, with low VOC emissions, was used for interiors, promoting a healthy living environment by preventing dust mites and enhancing air quality. Modular furniture was also designed for versatility, allowing it to be arranged vertically or horizontally to meet the functional needs and growing demands of occupants	Planning and design; R&D; construction; and maintenance. [4]	R1, R2. [2]	6

No.	Project	Practice	Location	Time frame*	Organisational setup*	Category	Details/highlights	Stage of Construction [weightage]	R model [weightage]	Total weightage
7	<b>BRAC University Landscaping and Renovation</b>	Development of a reuse and recycle plan based on baseline survey	BRAC University campus at Savar	November 2017 to June 2018	Waste Concern; Bengal Abashan Design & Research Limited / BRAC	Campus planning	For the Savar Residential Campus of BRAC University, Waste Concern Consultants conducted a baseline survey of solid waste, liquid waste (both black and grey water), and rainwater generated on the campus. They prepared designs and estimates for a decentralised wastewater treatment system, a solid waste recycling system, and a rainwater harvesting system based on the survey findings. The consultants oversaw the construction work and prepared an operations and maintenance manual for the decentralised wastewater treatment system.	Planning and zoning; planning and design of engineered structures; material extraction, R&D; construction; and maintenance, and facility management. [5]	R1, R2, R3, R7, R8. [5]	10
8	<b>Organic Clay Blocks</b>	Incorporate agricultural waste into clay blocks to enhance their properties, making them more suitable for construction.	Chattragram	Jan 2020 to April 2023	Liverpool John Moores University	Material research	This research explores the use of agro-wastes, such as eggshells, sawdust, coconut husks, and walnut shells, as alternative raw materials to enhance the performance of unfired clay blocks. The study provides valuable data on the potential benefits of these agro-wastes in manufacturing sustainable construction materials, addressing both waste management and thermal comfort in tropical climates. The research includes laboratory experiments and numerical thermal simulations to evaluate the properties of the enhanced clay blocks.	Material extraction, manufacturing, R&D. [1]	R1, R2, R7, R8. [4]	5

No.	Project	Practice	Location	Time frame*	Organisational setup*	Category	Details/highlights	Stage of Construction [weightage]	R model [weightage]	Total weightage
9	<b>Grameen Bank Housing Programme</b>	Supporting low-cost housing by providing low-interest loans to build modest, flood-resistant homes, with a focus on empowering women	Various locations, Bangladesh	1984 - 1989	Grameen Bank	Housing Programme	The Grameen Bank, a cooperative NGO, initially provided collateral-free loans to help the rural poor start income-generating activities, which proved successful. Building on this, the bank extended its support to housing, offering \$350 loans at 5% interest to build modest, flood-resistant homes, primarily for women. Each loan includes concrete columns, a sanitary slab, and roofing sheets, with additional materials supplied as needed. Using standard modules and precast materials, families build their own houses. In the first five years, 44,500 homes were constructed with a 98% repayment rate, and the program has been praised as a model for similar initiatives in developing countries.	Planning and design of engineered structures; manufacturing, R&D; construction; and maintenance, and facility management. [4]	R1, R2. [2]	6
10	<b>Karupannya Factory</b>	Energy conservation by passive design factory building	Alam Nagar, Rangpur	2013 - 2017	Karupannya Ltd	Industrial Building	The factory effectively cools its interior using traditional rural Bengal techniques, including natural airflow, water reservoirs, and strategically placed trees and plants. This design, featuring 12-foot ceilings, rooftop chimneys, and open southern sides, maintains an indoor temperature of 4 to 6 degrees cooler without air conditioning or fans. Additionally, the factory recycles 3,000 tons of cotton waste, 1,200 tons of garment scraps, and 4,500 tons of jute fiber annually in Shataranji production, reducing environmental pollution.	Planning and design of engineered structures; manufacturing; construction; and maintenance, facility management. [4]	R1, R2, R7, R8. [4]	8

No.	Project	Practice	Location	Time frame*	Organisational setup*	Category	Details/highlights	Stage of Construction [weightage]	R model [weightage]	Total weightage
11	<b>Pani Community Centre</b>	Promote awareness among locals about the basic principles of sustainability and durable building practices.	Rajarhat, Kuri-gram	2014	Dutch foundation Pani	Cultural Architecture, Community Center	The Pani Community Center features two volumes beneath an elevated bamboo roof that minimises heat buildup, supported by cross-ventilation, vegetation, and a nearby pond. Designed with locally sourced materials, e.g., mango wood, reused steel, bamboo, and hand-shaped brick, the project emphasises sustainable construction within a 15-mile radius. An innovative brickwork bond reduces costs and wood use by combining bamboo with thin concrete floors while maintaining the benefits of local materials and craftsmanship.	Planning and design of engineered structures; materials; and construction, and maintenance. [4]	R0, R1, R2, R3. [4]	8
12	<b>Friendship Centre</b>	Benchmark for sustainable, climate-resilient architecture in flood-prone regions.	Gaibandha, Bangladesh	2008-2010	Friendship NGO	Architecture, Centre for meetings, training, conferences etc.	The Friendship Centre is a training facility designed for the NGO Friendship, which supports vulnerable communities living on riverine islands (chars). Inspired by the Buddhist monasteries of Mahasthangarh, the center embodies simplicity, functionality, and sustainability. Its design merges with the rural landscape, integrating local materials and passive cooling strategies. The project serves as a model for climate-responsive architecture, offering training spaces while generating income through rental services for meetings and conferences.	Planning and zoning; planning and design of engineered structures; material extraction, R&D; construction; and maintenance, and facility management. [5]	R0, R1, R2, R3, R8. [5]	10

No.	Project	Practice	Location	Time frame*	Organisational setup*	Category	Details/highlights	Stage of Construction [weightage]	R model [weightage]	Total weightage
13	<b>HBRI-Friendship Cyclone Resilient Homes</b>	Cyclone-resilient homes to withstand extreme weather events.	Chakla Purbo Para, Pratapnagar, Asasuni, Satkhira  Paschim Patakhali, Padmapukur, Shyamnagar, Satkhira  Dokkhin Ulubunia, Sonaitala, Mongla, Bagerhat  Nazipur, Alipur, kalapara, Patuakhali	2014	Friendship NGO  Housing and Building Research Institute (HBRI)	Shelter Cluster	The HBRI-Friendship Cyclone Resilient Homes project is a locally-led adaptation initiative designed to provide disaster-resistant housing solutions in Bangladesh's coastal areas. The project integrates climate-resilient design principles, local materials, and community engagement to create homes that serve as both everyday residences and emergency shelters. Unlike traditional cyclone shelters, these structures can accommodate up to six vulnerable families during disasters while maintaining a cost-effective and environmentally friendly design.	Planning and zoning; planning and design of engineered structures; material extraction, R&D; construction; maintenance; and facility management. [5]	R0, R1, R2, R8. [4]	9
14	<b>Recycled Plastic in Roads</b>	Focus on conserving the environment while reducing the time and cost involved in road construction.	Pirujali Sarakghata in Gazipur	2019-2023	Local Government Engineering Department (LGED)	Transport Infrastructure	A 100-meter-long road was built using a mixture of bitumen and plastic waste, marking the first project of its kind in the country. The construction used a blend of 9 percent plastic waste and 91 percent bitumen, combined with sand and stones, heated to 170 degrees Celsius before application. This innovative use of plastic waste, which typically ends up in landfills and significantly contributes to environmental pollution, represents a step forward in sustainable infrastructure.	Planning and design of engineered structures; material extraction, R&D; and construction work, incl. logistics. [3]	R1, R2, R3, R7, R8. [5]	8

No.	Project	Practice	Location	Time frame*	Organisational setup*	Category	Details/highlights	Stage of Construction [weightage]	R model [weightage]	Total weightage
15	<b>FaL-G Bricks/ Blocks</b>	Brick Manufacturing Demonstration and Training Project	Dhaka	Nov 2018- Dec-2021	Department of Environment (DoE), Housing and Building Research Institute	Construction Materials	This FAL-G technology for making fly ash bricks will significantly reduce local air pollution (including significant dust and particulate matter) and greenhouse gas emissions, while also reducing the denudation of fertile topsoil that occurs during clay brick production. The project's goal was to displace demand for fossil fuels (primarily coal) because the FAL-G process does not require sintering. The project will also reduce the environmental impacts associated with the disposal of potentially harmful by-products of power plant operations, such as fly ash, by using these waste ducts as building material. Replacing and developing FAL-G Brick reduces air pollution and helps preserve topsoil on agricultural land. The project also has positive employment aspects: it will create business opportunities for small entrepreneurs who wish to open new FAL-G brick-making units and will improve employment opportunities for brick workers, who will now have more year-round work. The project will introduce technology to produce Blocks from Fly Ash, Lime, gypsum, cement and sand.	Material extraction, research and development. [1]	R1, R2, R6, R7, R8. [5]	6

No.	Project	Practice	Location	Time frame*	Organisational setup*	Category	Details/highlights	Stage of Construction [weightage]	R model [weightage]	Total weightage
16	<b>HBFC House Renovation Loan</b>	House Renovation Loan	All over Bangladesh		House Building Finance Corporation	Housing Finance	House Building Finance Corporation was established in 1952 to provide financial assistance in the housing sector. The Corporation's primary source of funds is the paid-up capital contributed by the Government. The authorised capital is Taka 1000 Crore, and during 2010-11, the total paid-up capital stood at Taka 110 crore. In addition, the corporation raised funds by selling Govt.-guaranteed debentures, with the assistance of the Ministry of Finance, to the Bangladesh Bank and other Commercial Banks. This Financing Institute has several finance streams. Among them, the Building Repair and Maintenance Skim is also available to borrowers. The interest rate is about 8% in rural areas and 9% in urban areas. The maximum loan ceiling is 25 lac BDT for a tenure of 15 years.	Planning, design; and construction. [2]	R6, R7. [2]	4

## Appendix C. Integration of circular economy practices across six stages of construction

No.	Project Name	Stage of Construction	Urban and Rural Planning and Zoning	Planning and Design of Engineered Structures	Material Extraction, Manufacturing, R&D	Construction Works, Including Logistics	Maintenance and Facility Management	Deconstruction and Demolition	Total
1	<b>Second-hand Construction Material Market</b>	Material extraction, manufacturing; and deconstruction and demolition. [2]			1			1	2
2	<b>Vernacular Houses</b>	Planning and Design of engineered structures; material extraction, manufacturing; construction; and maintenance. [4]		1	1	1	1		4
3	<b>SUSBUILD Bangladesh</b>	Planning and design; materials, R&D; construction; and maintenance. [4]		1	1	1	1		4
4	<b>METI School</b>	Planning and design of engineered structures; materials; construction; and maintenance. [4]		1	1	1	1		4

No.	Project Name	Stage of Construction	Urban and Rural Planning and Zoning	Planning and Design of Engineered Structures	Material Extraction, Manufacturing, R&D	Construction Works, Including Logistics	Maintenance and Facility Management	Deconstruction and Demolition	Total
5	<b>Recycling Concrete</b>	Planning and design of engineered structures; material extraction, R&D; construction; maintenance; and deconstruction and demolition. [5]		1	1	1	1	1	5
6	<b>HealBRIC Green Apartment</b>	Planning and design; R&D; construction; and maintenance. [4]		1	1	1	1		4
7	<b>BRAC University Landscaping and Renovation</b>	Planning and zoning; planning and design of engineered structures; material extraction, R&D; construction; and maintenance, and facility management. [5]	1	1	1	1	1		5
8	<b>Organic Clay Blocks</b>	Material extraction, manufacturing, R&D. [1]			1				1

No.	Project Name	Stage of Construction	Urban and Rural Planning and Zoning	Planning and Design of Engineered Structures	Material Extraction, Manufacturing, R&D	Construction Works, Including Logistics	Maintenance and Facility Management	Deconstruction and Demolition	Total
9	<b>Grameen Bank Housing Programme</b>	Planning and design of engineered structures; manufacturing, R&D; construction; and maintenance, and facility management. [4]		1	1	1	1		4
10	<b>Karupannya Factory</b>	Planning and design of engineered structures; manufacturing; construction; and maintenance, facility management. [4]		1	1	1	1		4
11	<b>Pani Community Centre</b>	Planning and design of engineered structures; materials; and construction, and maintenance. [4]		1	1	1	1		4
12	<b>Friendship Centre</b>	Planning and zoning; planning and design of engineered structures; material extraction, R&D; construction; and maintenance, and facility management. [5]	1	1	1	1	1		5

No.	Project Name	Stage of Construction	Urban and Rural Planning and Zoning	Planning and Design of Engineered Structures	Material Extraction, Manufacturing, R&D	Construction Works, Including Logistics	Maintenance and Facility Management	Deconstruction and Demolition	Total
13	<b>HBRI-Friendship Cyclone Resilient Homes</b>	Planning and zoning; planning and design of engineered structures; material extraction, R&D; construction; maintenance; and facility management. [5]	1	1	1	1	1		5
14	<b>Recycled Plastic in Roads</b>	Planning and design of engineered structures; material extraction, R&D; and construction work, incl. logistics. [3]		1	1	1			3
15	<b>FaL-G Bricks/Blocks</b>	Material extraction, research and development. [1]			1				1
16	<b>HBFC House Renovation Loan</b>	Planning, design; and construction. [2]		1		1			2
		<b>Total</b>	<b>3</b>	<b>13</b>	<b>15</b>	<b>13</b>	<b>11</b>	<b>2</b>	<b>57</b>

## Appendix D. Application of the 10R Framework across various projects, emphasising different circular economy strategies.

No.	Project Name	R model	R0 Refuse	R1 Rethink	R2 Reduce	R3 Reuse	R4 Repair	R5 Refurbish	R6 Remanufacture	R7 Repurpose	R8 Recycle	R9 Recover	Total
1	<b>Second-hand Construction Material Market</b>	R0, R1, R3, R4, R5, R6, R7, R8	1	1		1	1	1	1	1	1		8
2	<b>Vernacular Houses</b>	R1, R2		1	1								2
3	<b>SUSBUILD Bangladesh</b>	R0, R1, R2, R6, R7, R8	1	1	1				1	1	1		6
4	<b>METI School</b>	R1, R2, R3, R7		1	1	1				1			4
5	<b>Recycling Concrete</b>	R1, R2, R5, R6, R8		1	1			1	1		1		5
6	<b>HealBRIC Green Apartment</b>	R1, R2		1	1								2
7	<b>BRAC University Landscaping and Renovation</b>	R1, R2, R3, R7, R8		1	1	1				1	1		5
8	<b>Organic Clay Blocks</b>	R1, R2, R7, R8		1	1					1	1		4
9	<b>Grameen Bank Housing Programme</b>	R1, R2		1	1								2
10	<b>Karupannya Factory</b>	R1, R2, R7, R8		1	1					1	1		4

No.	Project Name	R model	R0 Refuse	R1 Rethink	R2 Reduce	R3 Reuse	R4 Repair	R5 Refurbish	R6 Remanufacture	R7 Repurpose	R8 Recycle	R9 Recover	Total
11	<b>Pani Community Centre</b>	R0, R1, R2, R3.	1	1	1	1							4
12	<b>Friendship Centre</b>	R0, R1, R2, R3, R8	1	1	1	1					1		5
13	<b>HBRI-Friendship Cyclone Resilient Homes</b>	R0, R1, R2, R8	1	1	1						1		4
14	<b>Recycled Plastic in Roads</b>	R1, R2, R3, R7, R8		1	1				1	1	1		5
15	<b>FaL-G Bricks/ Blocks</b>	R1, R2, R6, R7, R8		1	1				1	1	1		5
16	<b>HBFC House Renovation Loan</b>	R6, R7							1	1			2
		<b>Total</b>	<b>5</b>	<b>15</b>	<b>14</b>	<b>5</b>	<b>1</b>	<b>2</b>	<b>6</b>	<b>9</b>	<b>10</b>	<b>0</b>	<b>67</b>

**Notes:**

**R0 Refuse:** Make products redundant by abandoning their function or by offering the same function by a radically different (incl. digital) product or service.

**R1 Rethink:** Make product use more intensive (e.g., through product-as-a-service, reuse and sharing models or by putting multi-functional).

**R2 Reduce:** Increase efficiency in product manufacture or use by consuming fewer natural resources and materials.

**R3 Reuse:** Reuse of a product that is still in good condition and fulfils its original function (and is not wasted) for the same purpose for which it was conceived.

**R4 Repair:** Repair and maintenance of defective product so it can be used with its original function.

**R5: Refurbish:** Restore an old product and bring it up to date (to a specified quality level).

**R6 Remanufacture:** Use parts of a discarded product in a new product with the same function (and as-new condition).

**R7 Repurpose:** Use a redundant product or its parts in a new product with a different function.

**R8 Recycle:** Recover materials from waste to be reprocessed into new products, materials or substances, whether for the original or other purposes. It includes the reprocessing of organic material but does not include energy recovery and the reprocessing into materials that are to be used as fuels or for backfilling operations.

**R9 Recover:** Recovering energy content of materials in the waste stream.

## Appendix E. Stakeholder mapping and analysis

The stakeholder mapping and analysis exercise was conducted first to identify key actors across various sectors. Stakeholders involved in different capacities in the selected case study projects (e.g., SUSBUILD Bangladesh, Organic Clay Blocks, Recycling Concrete; HealBRIC Green Apartment; Friendship Centre, HBRI-Friendship Cyclone Resilient Homes, FaL-G Bricks/Blocks and HBFC House Renovation Loan as listed in Table 2) were prioritised, while stakeholder mapping was planned. The stakeholder mapping informed the selection of participants for subsequent interviews and group discussions, ensuring a diverse range of perspectives and expertise.

Semi-structured interviews were conducted with experts and stakeholders from various organisations, including Friendship International NGO, Liverpool John Moores University, the Bangladesh Concrete Products and Block Manufacturers Association (BCPBMA), the University of Melbourne, and GIZ. A set of structured questionnaires, followed by a short presentation, was used during the interviews to initiate discussions and gather information on key areas, including resource consumption, market trends, environmental impact, policy support, challenges and solutions, and calls to action. Thematic translation of the questionnaire into Bangla was also provided, as needed, to ensure accessibility and clarity for participants. Appendix D presents the full set of questionnaires used during semi-structured interviews.

In addition to interviews, multiple discussions were attended to facilitate knowledge exchange and collaborative brainstorming on pilot project concepts. These discussions engaged key stakeholders such as the Bangladesh Power Development Board (BPDB), the International Finance Corporation (IFC), the Department of Architecture at Chittagong University of Engineering and Technology (CUET), the Embassy of the Republic of Korea, the Bangladesh House Building Finance Corporation (BHBFC), and other relevant entities. The discussions focused on themes including Sustainable Consumption and Production (SCP), Circular Economy (CE), Healthy Building Research and Innovation Concept (HealBRIC), nearly Zero Emissions Communities (neZECOM), green building certification, and international best practices for resilient and circular construction. The dialogue activities emphasised cross-sectoral collaboration and the integration of circular economy principles into national policies.

**Table 4. Stakeholder Dialogue Activities to create a collaborative and supportive environment for SCP initiatives in Bangladesh.**

No.	Date	Activity	Person/ Theme	Stakeholder Institutions
0	20 Nov 2024	Stakeholder Mapping and Analysis		
1	25 Mar 2025	Interview	Mr. Kazi Amdadul Hoque, Senior Director-Strategic Planning & Head of Climate Action, Friendship.	Friendship International NGO, Dhaka.
2	25 Feb 2025	Interview	Dr. Nusrat Jannat, Assistant Professor, CUET.	Liverpool John Moores University, England.
3	23 Feb 2025	Interview	Mr. Zulkor Shahin Secretary-General, BCPBMA.	Bangladesh Concrete Products and Block Manufacturers Association, Dhaka.
4	22 Feb 2025	Group Discussion	The Role of Power Sector in Sustainable and Environment-Friendly Development: Bangladesh Perspective	Bangladesh Power Development Board (BPDB)
5	22 Jan 2025	Group Discussion	Excellence in Design for Greater Efficiencies (EDGE) & Building Resilience Index (BRI)	International Finance Corporation (IFC)- World Bank Group

No.	Date	Activity	Person/ Theme	Stakeholder Institutions
6	03 Jan 2025	Interview	Dr Masa Noguchi, Associate Professor in Environmental Design at the Faculty of Architecture, Building and Planning.	University of Melbourne, Australia.
7	18 Dec 2024	Group Discussion	Resilient Architecture Towards Sustainable Bangladesh	Department of Architecture, Chittagong University of Engineering and Technology (CUET), Chattogram, Bangladesh.
8	17 Dec 2024	Group Discussion	Smart Innovation through Korea-Bangladesh Cooperation: Towards Sustainable Cities	Embassy of the Republic of Korea and the Korea Trade Promotion Agency (KOTRA)
9	12 Dec 2024	Group Discussion	Guideline for Green Residential Building Model of BHBFC	Bangladesh House Building Finance Corporation (BHBFC)
10	9 Dec 2024	Interview	Hamidul Islam Chaudhary, Cluster Project Manager Climate Change and Sustainable Urban Development Cluster, GIZ.	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH, Dhaka, Bangladesh

## Appendix F. Full set of questionnaires used during semi-structured interviews.

1. Resource Consumption	1. নর্মাণ উপকরণ
a) What are the primary materials used in the construction sector of Bangladesh?	a) বাংলাদেশে নর্মাণ খাতে প্রধানতঃ কী কী উপকরণ ব্যবহৃত হয়?
b) How these construction materials are sourced?	b) এই নর্মাণ উপকরণগুলি মূলতঃ কোথা থেকে আসে?
c) What supply chain issues or dependencies exist in the construction sector?	c) নর্মাণ খাতে উপকরণ সরবরাহের সমস্যা ও নির্ভরতাগুলি কী কী?
d) What quality and availability advantages do local material suppliers offer?	d) সরবরাহকারীরা কীভাবে সহজলভ্য নর্মাণ উপকরণে গুণগত মান নিশ্চিত করে?
e) How do material suppliers contribute to sustainable construction efforts?	e) সরবরাহকারীরা নর্মাণকে টেকসই করার জন্য কী করে?
f) How can material suppliers improve their sustainability practices?	f) সরবরাহকারীরা কীভাবে তাদের নর্মাণকে আরো টেকসই করতে পারে?
2. Market Trends	2. নর্মাণ বাজার
a) What competencies do national contractors have in sustainable construction?	a) ঠিকাদারদের মধ্যে টেকসই নর্মাণের জন্য কী কী দক্ষতা আছে?
b) Which successful projects highlight their capabilities?	b) বাংলাদেশে ঠিকাদারদের টেকসই প্রকল্প নর্মাণের কী কী উদাহরণ আছে?
c) What trends are emerging in sustainable construction practices?	c) নর্মাণকে টেকসই করার জন্য কী কী নতুন পদ্ধতির আগমন ঘটছে?
d) How do consumer preferences influence these trends?	d) এই ধরনের নতুন টেকসই প্রযুক্তি কী মালিকদেরকে আকৃষ্ট করতে পারে?
e) Is the manufacturer addressing circularity in their marketing strategy?	e) উৎপাদনকারীরা কীভাবে বর্ষা কৌশলে সার্কুলারিটি বিপারটা মাথায় রেখেছে?
f) How can contractors enhance their skills in circular practices?	f) ঠিকাদাররা কীভাবে সার্কুলারিটি রক্ষার জন্য তাদের দক্ষতা বাড়াতে পারে?
g) What areas need improvement or support?	g) কোন্ কোন্ ক্ষেত্রে উন্নতি ও সহায়তা প্রয়োজন বলে মনে করেন?
3. Environmental Impact	3. পরিবেশগত প্রভাব
a) What are the main environmental challenges faced by the construction sector?	a) নর্মাণ খাতের কারণে প্রধান পরিবেশগত হুমকিগুলি কী কী?
b) What challenges exist in reducing resource consumption and waste?	b) নর্মাণ উপকরণে ব্যবহার এবং বর্জ্য কমাতে প্রধান অন্তরায় কী কী?
c) What new technologies or approaches could drive circularity in construction?	c) কী ধরনের নতুন প্রযুক্তি বা পদ্ধতি নর্মাণ ক্ষেত্রে সার্কুলারিটি আনতে পারে?
d) How can digital tools enhance efficiency and sustainability?	d) কী ধরনের ডিজিটাল টুল দক্ষতা এবং টেকসই নর্মাণ নিশ্চিত করতে পারে?

4. Policy Support	4. নীতিনির্ধারণ
a) Is the current 3R policy of Bangladesh adequate to promote circularity in the construction sector?	a) বাংলাদেশের বর্তমান 3R নীতিনির্ধারণ খাতে সার্কুলারিটিনিশ্চিত করতে পারবে?
b) What government incentives or programs support circular economy initiatives?	b) কধিরনের সরকারী প্রণোদনা বা কর্মসূচিসার্কুলার ইকোনমি উদ্যোগকে সফল করতে পারে?
c) Are public procuring entities trained in sustainable procurement or circularity?	c) পাবলিক প্রকৌর্কটির প্রতষ্ঠানগুলি কি টেকসই ক্রয় ও সার্কুলারিটি সম্পর্কে প্রশিক্ষণ আছে?
d) What aspects need to be addressed or included in the circularity policy?	d) সার্কুলারিটিনিতি প্রতষ্ঠান জন্য আমাদের নীতমিলায় কিকি বিষয় অন্তর্ভুক্ত করতে হবে বলে মনে করেন?
e) How can policies be strengthened to promote sustainability further?	e) টেকসই নীতগিলিকে কভিবে আরও কার্যকরী করা যতে পারে?
5. Challenges and Solutions	5. চ্যালেঞ্জ এবং সমাধান
a) What is the current state of circular economy practices in the construction sector?	a) নির্মাণ খাতে সার্কুলার ইকোনমি চর্চা কভিবে হচ্ছে?
b) What challenges can be faced in implementing the 10R framework?	b) 10R কাঠামো বাস্তবায়ন কী ধরনের চ্যালেঞ্জের মুখে পরতে পারে?
c) How can these challenges be addressed or overcome?	c) এই চ্যালেঞ্জগুলি কীভাবে মোকাবলো করা যতে পারে?
d) How can ongoing efforts be sustained and improved?	d) নির্মাণ প্রক্রিয়ায় বদ্যমান সার্কুরালটির চর্চাগুলো কীভাবে আরও বাড়ানো যায়?
e) What steps should stakeholders take to advance circular economy principles further?	e) সার্কুলার ইকোনমি নীতগিলি আরও এগিয়ে নেওয়ার জন্য স্টকেহোল্ডারদের কিকি পদক্ষেপে নেওয়া উচিত?
6. Call to Action	6. পরিকল্পনা ও বাস্তবায়ন
a) What specific aspects of the building lifecycle should be addressed to implement circularity or circular economy in the context of Bangladesh?	a) বাংলাদেশের প্রক্শাপটে সার্কুরালটির বা সার্কুলার ইকোনমি বাস্তবায়নের জন্য বলিডিং ডিজাইন থেকে শুরু করে ডমেশন ধাপগুলি মধ্যে কোনটিতে জোর দেওয়া উচিত?
b) What are the suggested actions for stakeholders to enhance circular economy practices in the context of Bangladesh?	b) বাংলাদেশের প্রক্শাপটে সার্কুলার ইকোনমি ব্যপক প্রচলন নিশ্চিত করার জন্য স্টকেহোল্ডারদের জন্য কিকি করতে হবে?
c) What specific actions are recommended for governments, industry leaders, and other stakeholders?	c) সরকার, ব্যবসায়ী নেতৃবৃন্দ এবং অন্যান্য স্টকেহোল্ডারদেরকে সার্কুরালটির ব্যাপারে আগ্রহী করার জন্য কিকি করতে হবে?
d) How can collaboration be strengthened across different sectors?	d) সার্কুরালটি প্রক্শাপটসি আনার জন্য বিভিন্ন খাতের মধ্যে কীভাবে আরও সমন্বয় বাড়ানো যায়?
e) How EU programs could be integrated to foster collaboration and business ties further?	e) ইউরোপীয় ইউনিয়ন কীভাবে এক্ষেত্রে সহযোগিতা এবং সমন্বয় করতে পারে?

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