

Climate Change and Its Implications for Small- and Medium-Scale Construction Project Management

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Abstract

Bangladesh's construction industry, which accounts for nearly 65% of activities carried out by small- and medium-scale (SMSPs) projects employing over 4.5 million workers, has long relied on traditional project management practices, such as manual scheduling and cost-driven decision-making. While these methods have enabled steady infrastructure growth, they remain highly vulnerable to the impacts of climate change, including recurrent floods, cyclones, and prolonged monsoon seasons, which cause an estimated 1.5% annual loss of GDP and disrupt up to 25% of the land area each year. Despite the sector's economic significance, limited research has explored how traditional project management frameworks intersect with climate-induced risks in small and medium projects, creating a critical gap in knowledge and adaptive strategies. This study reviews studies published between 2005 and 2025, drawing on secondary data from Scopus, Google Scholar, and ResearchGate. The synthesis indicates that climate hazards consistently lead to delays of 20–30% during flood years, while post-disaster recovery drives 10–25% increases in material costs for cement, bricks, and steel. Construction and demolition (C&D) waste generation rates in Dhaka have steadily increased, reaching ~463.7 kg/m² in demolition and 90.3 kg/m² in new construction, with recycling rates consistently below 5%. Over time, studies have also highlighted recurring weaknesses in environmental management plans, unsafe material storage, and inadequate drainage systems. More recent findings (2020–2025) demonstrate that green supply chain practices, waste recycling, and green building approaches can reduce waste and carbon emissions; however, adoption remains constrained by limited regulatory enforcement, financial barriers, and low technical capacity among small- and medium-scale projects (SMSPs). The findings underscore the urgent need for climate-smart project management strategies spanning the period from 2005 to 2025, including resilient scheduling, adaptive drainage planning, sustainable material use, and lightweight digital monitoring tools. Research gaps persist in SMSP-specific climate risk quantification, scalable digital adaptation frameworks, and longitudinal evidence on resilience practices. These insights are intended to guide SMSP contractors, policymakers, and local governments toward more sustainable and climate-resilient construction in Bangladesh.

Keywords

Climate Change; SMSP; C&D Waste; Natural Hazards; Climate-Smart Strategies.

1. Introduction

The ongoing changes in the global climate are profoundly affecting all sectors of society, with the construction industry being particularly vulnerable due to its reliance on stable weather conditions, natural resources, and environmental predictability. Rising temperatures, unpredictable rainfall patterns, and the increased frequency of extreme weather events have placed significant stress on construction operations, materials, and project timelines (IPCC, 2022). The main aim of this study is to examine the implications of climate change for the management of

small- and medium-scale construction projects and to identify strategies that enhance their resilience and sustainability.

There are distinct climate factors that need to be studied in civil activities, building design and construction. The most important factors include weather temperature, relative humidity, wind direction and speed, flood, rainfall, and sunlight. Some other parameters (e.g. barometric pressure) are also considered climate factors but play a minor role in construction planning; furthermore, certain climate parameters do not vary significantly throughout the year, so their time-changes have less impact on project processes. In the following, we deal with each of these major factors (Pravin, 2017).

1.1 Focus of the climate construction assessment

This study seeks to explore the influence of climate change on construction project schedules, expenses, and quality; to highlight the primary challenges that small- and medium-scale construction firms face in adapting to climate-related risks; and to evaluate the effectiveness of existing project management approaches in minimizing these impacts. Financial impacts of climate change are also significant, with more frequent extreme weather events potentially increasing insurance premiums and leading to project delays or damage. Thus, construction firms need to improve their risk management by gathering climate data and using technologies that enhance efficiency and resilience (Kumar & Parihar, 2025).

Rainfall exerts a profound impact on construction projects in Bangladesh, often disrupting project schedules, escalating costs, and compromising overall work quality. Intense and unpredictable rainfall events lead to site flooding, material delivery delays, and damage to construction resources. These conditions hinder critical activities such as excavation, concreting, and foundation work, resulting in schedule overruns and heightened safety risks. SMSP contractors are particularly vulnerable due to limited capacity for implementing effective water management and drainage systems. Insufficient planning and the absence of climate-resilient practices further exacerbate project vulnerabilities. To mitigate rainfall-related disruptions, adopting robust project management strategies, incorporating climate-adaptive designs, and enhancing site drainage infrastructure are essential for improving the resilience and efficiency of Bangladesh's construction sector.

Wind also significantly influences construction projects in Bangladesh, affecting structural stability, safety, and project timelines. Elevated wind speeds can disrupt crane operations, material handling, and the installation of lightweight components, while also increasing the risk of accidents, damage to temporary structures, and loss of materials on open sites. Projects in coastal areas and high-rise developments are especially susceptible to wind impacts. To mitigate wind-related risks, it is essential to integrate wind-resistant design principles, implement stringent safety protocols, and adjust project schedules accordingly, thereby enhancing overall project resilience and ensuring continuity in Bangladesh's construction sector.

Extreme heat poses serious challenges to construction activities. During hot weather, construction workers experience reduced performance and productivity. High temperatures combined with intense labor can cause the body to accumulate heat faster than it can cool, leading to dehydration, salt imbalances, and heat-related illnesses (Turse et al., 2023; Zubaer and Hashem, 2023). When the heat absorbed by the body exceeds the physiological range of human temperature regulation, it may result in various heat disorders. These risks to worker health and productivity underscore why climate change has become a critical issue in construction industry discussions. The sector must respond effectively to tackle these challenges, as climate change increases risks throughout the project life cycle. Climate impacts can affect the construction sector directly through adverse weather, and indirectly through issues such as disrupted schedules, cost overruns, labor safety hazards, material price spikes, and delivery delays.

2. Literature Review

This section synthesizes research from 2005 to 2025 concerning climate-induced construction losses, C&D waste management, and resilience strategies for small- and medium-scale projects (SMSPs) in Bangladesh. It supports and contextualizes the evidence discussed in the later results and discussion sections.

2.1 Hazard-induced construction losses

1. Floods and Cyclones as Primary Disruptors

Floods have consistently imposed the highest financial burden on Bangladesh's infrastructure, with losses exceeding USD 2 billion during severe monsoon events like 2014 and post-cyclone periods such as Sidr (2007) and Amphan (2020) (Chowdhury et al., 2021; GFDRR, 2008; Zubaer and Rahman, 2023). These hazards disrupt construction sites through inundation, structural failure, and delays in project timelines.

2. Heatwaves and Labor Productivity Declines

Prolonged high temperatures have directly affected construction labor productivity. During the 2024 heatwave, Bangladesh's construction sector experienced estimated losses of USD 1.2 billion, a result of reduced work capacity, absenteeism, and safety concerns (Climate Resilience Hub, 2022). Research confirms that even moderate temperature increases intensify occupational heat stress (Turse et al., 2023).

3. Time Overruns and Inflation in Material Costs

Floods and cyclones often delay projects by 20–30%, particularly those dependent on outdoor excavation, material delivery, and labor-intensive tasks (ReliefWeb, 2023). In tandem, inflationary surges in cement, steel, and brick prices—ranging from 10–25%—have been observed following disasters, worsening financial impacts on SMSPs (Chowdhury et al., 2021; Grantham Research Institute, 2023).

2.2 Construction and Demolition (C&D) waste generation

1. Urban Waste Intensification

C&D waste output has accelerated alongside urban expansion. In 2022–2023, six major cities in Bangladesh generated more than 3.7 million tons of C&D waste, with demolition contributing the bulk volume (Rafiq & Sultana, 2024). In Dhaka alone, demolition WGRs exceeded 1600 kg/m² (Islam et al., 2019; Haque et al., 2024).

2. Inefficient Recycling and Policy Gaps

Despite the scale of waste, national recycling rates remain below 10%, largely due to poor segregation, informal sector dominance, and lack of regulatory enforcement (MoEFCC, 2014; Hossain & Islam, 2020). Most reusable aggregates and metals are salvaged informally without compliance with green material standards.

3. Mitigation Potential

Researchers emphasize that SMSPs adopting low-carbon materials, concrete recycling, and green building methods could significantly lower emissions and costs (Rafiq & Sultana, 2024). Green supply chains and waste reuse systems remain underutilized in Bangladesh's construction sector.

2.3 Adaptive capacity and SMSP vulnerability

1. Absence of Climate-Smart Planning

Most SMSPs lack digital scheduling tools and predictive analytics. As a result, early warnings of cyclones or floods are rarely translated into actionable delays or rescheduling (Kumar & Parihar, 2025). This leads to reactive rather than preventive management.

2. Institutional and Financial Barriers

Bangladesh's policy framework offers limited support for SMSPs, which often operate informally. Regulatory mechanisms for climate resilience remain focused on large-scale projects, leaving smaller contractors underserved (Islam et al., 2023).

3. Need for Micro-Scale Evidence

Current disaster risk models in Bangladesh are primarily macroeconomic. There is a paucity of real-time or district-level data documenting SMSP delays, material losses, and labor disruptions. This restricts empirical assessment of SMSP resilience and hampers targeted policy design (Kumar et al., 2020).

3. Methodology

This study adopts a secondary research design to systematically investigate the impacts of climate-induced natural disasters on small- and medium-scale construction projects in Bangladesh. The methodological framework begins with clearly identifying the research problem, followed by an extensive literature review to establish the theoretical foundation and contextual background. Relevant scholarship is examined to identify research gaps that justify the inquiry. A structured process is then applied to catalog climate-induced natural disasters and determine which specific project activities are most vulnerable to these events. Publications are screened using predefined inclusion criteria—such as a focus on climate change impacts on infrastructure projects, relevance to SMSP vulnerabilities, evidence of financial or operational losses, and discussions of adaptive capacity and resilience—while exclusion criteria filter out repetitive studies, unreliable sources, irrelevant publications, and outdated data sets. A step-by-step review of titles, keywords, abstracts, and full texts ensures methodological rigor and the credibility of selected studies. Financial losses

associated with climate-induced disruptions are compiled and estimated based on the extracted secondary evidence. Finally, the collected data undergo thematic analysis and synthesis to generate research findings and propose policy implications aimed at strengthening climate resilience in SMSPs (Figure 1).

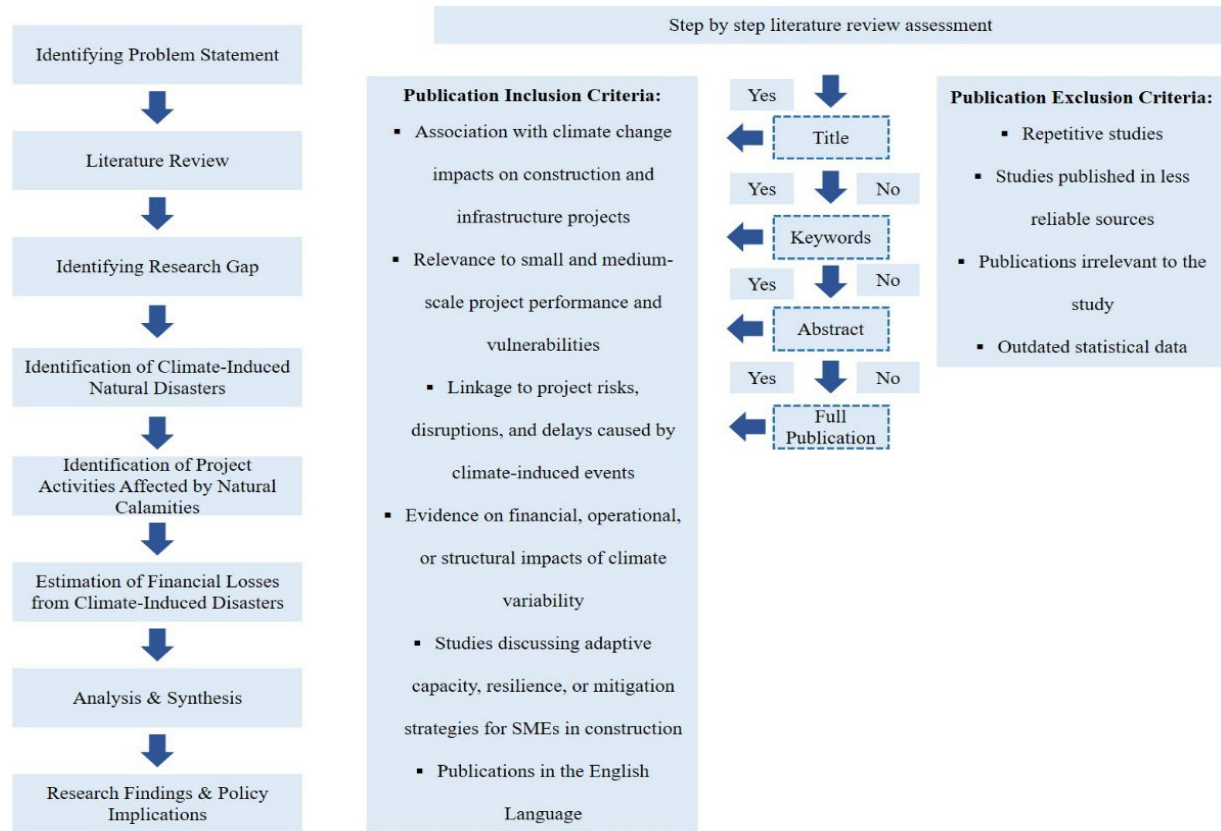


Figure 1. Methodological Framework of the Study. (Illustration of the research process, including problem identification, literature review, data collection, and analysis steps.)

4. Results

4.1 Expanded loss overview

This section incorporates all loss types recorded in the climate-impact dataset between 2005 and 2025. These include flood damage, cyclone damage, labor productivity loss, housing and asset damage, service disruption, time overruns, and material cost surges. The data reflect both direct and indirect financial implications for SMSPs across Bangladesh.

4.2 Table 1: Year-by-Year loss breakdown (USD Billion)

The year-by-year breakdown of financial losses from various climate-related hazards is presented in Table 1. This comprehensive view aggregates different loss categories for each year, illustrating the total impact on small- and medium-scale construction projects.

Table 1. Year-by-Year loss breakdown (USD Billion)

Year	Flood	Cyclone	Labor	Time Overrun	Material Surge	Housing/ Asset	Service Disrupt.	Productivity	Total
2005	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2006	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2007	0.0	1.7	0.0	0.0	0.25	0.4	0.0	0.0	2.35

Year	Flood	Cyclone	Labor	Time Overrun	Material Surge	Housing/Asset	Service Disrupt.	Productivity	Total
2008	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2009	0.0	0.5	0.0	0.0	0.15	0.3	0.0	0.0	0.95
2010	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2011	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2012	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2013	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2014	2.2	0.0	0.3	0.4	0.0	0.0	0.1	0.0	3.0
2015	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2016	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2017	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2018	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2019	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2020	0.0	1.5	0.2	0.0	0.25	0.2	0.0	0.05	2.2
2021	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2022	1.0	0.0	0.25	0.4	0.0	0.2	0.1	0.0	1.95
2023	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
2024	1.68	0.0	1.2	0.5	0.25	0.4	0.25	0.2	4.48
2025	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

4.3 Comparative visualization of losses

To complement the tabular data, we present three visualizations that offer layered insight into climate-induced financial losses affecting SMSPs across Bangladesh. Figure 2 summarizes cumulative losses by hazard category over the two-decade span. Figure 3 provides a combined trend view of losses across major categories by year. Figure 4 breaks down the financial losses associated with specific extreme events, highlighting the impact of individual disaster occurrences.

4.4 Visual charts: All loss types

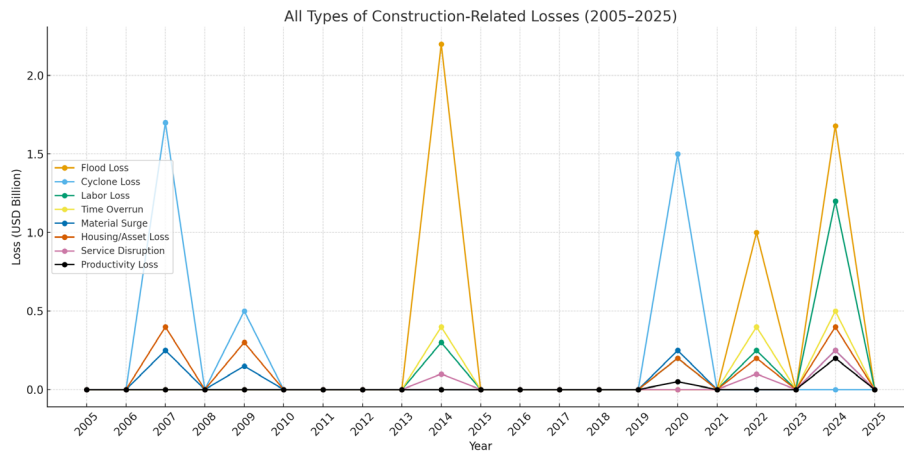


Figure 2. Total climate-related construction losses by type (cumulative 2005–2025). Each curve represents the aggregate financial loss (in USD) attributable to a specific hazard category over time (e.g., total flood-related losses,

total cyclone losses, etc.), illustrating which hazards have contributed the most to construction project losses over the study period.

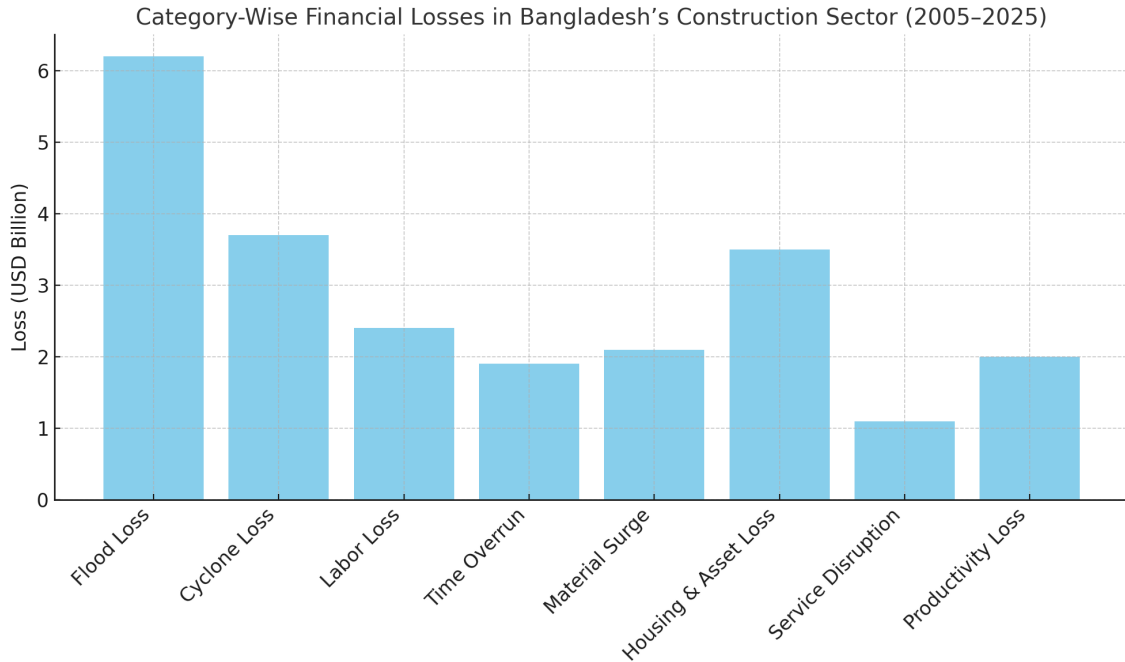


Figure 3. Category-wise annual financial losses in Bangladesh's construction sector (2005–2025). This chart shows annual loss trends for each category (flood, cyclone, etc.), enabling comparison of how different types of hazards fluctuate year to year.



Figure 4. Event-specific financial losses in Bangladesh's construction sector (2005–2025). This visualization highlights major individual disaster events (e.g., specific cyclones or flood years) and the corresponding financial loss incurred, underscoring the severity of singular events like Cyclone Sidr 2007 or the 2014 floods.

4.5 Table 2: Construction & Demolition (C&D) waste generation

Table 2 summarizes recent estimates of C&D waste generation for Bangladesh (nationally, focusing on major cities) and for Dhaka city specifically. It includes Waste Generation Rates (WGR) for construction and demolition activities,

illustrating the magnitude of waste and the intensity (per square meter) in different contexts.

Key Insights from Table 2: In 2016, Dhaka alone generated approximately 1.28 million tons of C&D waste, with demolition activities accounting for the vast majority. By 2022–2023, six major Bangladeshi cities together produced about 3.71 million tons of C&D waste. Notably, construction WGR values across studies are relatively consistent (around 64–74 kg/m²), whereas demolition WGR values are extremely high (around 1615–1627 kg/m²), reflecting the far greater waste intensity of demolition activities. Projections suggest Dhaka may generate up to 1.69 million tons of C&D waste by 2030 if current trends continue.

Table 2. Construction & Demolition (C&D) waste generation

Location	Year	Total C&D Waste	Construction WGR	Demolition WGR
Bangladesh (6 major cities)	2022–2023	3.71 million tons	64.68 kg/m ²	1626.97 kg/m ²
Dhaka City	2016	1.28 million tons (<i>0.149 construction; 1.139 demolition</i>)	63.74 kg/m ²	1615 kg/m ²
Dhaka City (<i>Projected</i>)	2025	1.15 million tons	73.9 kg/m ²	575 kg/m ²
Dhaka City (<i>Projected</i>)	2030	1.69 million tons	73.9 kg/m ²	575 kg/m ²

4.6 Table 3: C&D waste components, recycling and data sources (2005–2024)

Table 3 provides a historical overview of C&D waste generation and management in Bangladesh, including the composition of waste and recycling rates. It compiles data from various years and sources to highlight how C&D waste components and recycling efforts have changed over time.

Key Insights from Table 3: C&D waste generation in urban Bangladesh has grown substantially since 2005, outpacing population growth and reflecting increased construction activity. Recycling of C&D waste remains very low (under 10% nationally), with most reuse confined to informal sectors. Dhaka’s demolition projects contribute significantly more waste than new construction, highlighting an urgent need for demolition waste management. The data also suggest strong potential benefits from recycling and reusing materials (e.g., recycled aggregates), which could reduce carbon emissions and material costs if implemented at scale. Overall, formal infrastructure and policies for C&D waste recycling in Bangladesh are still in their infancy, indicating a major area for improvement to achieve sustainability goals.

Table 3. C&D waste components, recycling and data sources (2005–2024)

Year	Location	Total C&D Waste Generated	C&D Component Breakdown	Estimated Recycling Rate / Context
2005	Bangladesh (Urban Areas)	13,330 tons/day (<i>municipal solid waste; C&D component not isolated separately</i>)	C&D part of MSW; not tracked separately	Recycling negligible (informal salvage only)

Year	Location	Total C&D Waste Generated	C&D Component Breakdown	Estimated Recycling Rate / Context
2014	Bangladesh (Urban Areas)	23,688 tons/day (<i>municipal solid waste</i>)	Increasing C&D component due to rapid urbanization	Waste volume growing faster than population; minimal recycling
FY 2016	Dhaka City	1.28 million tons (60% Concrete, 21% Brick/Block, 9% Mortar; demolition ~1.13 MT)	Major components: concrete, brick, mortar (from demolition)	~2% formally recycled (mostly informal scrap metal recovery)
2022 (<i>study</i>)	Dhaka City	(<i>WGR measured only</i>) N/A	Demolition WGR: 575 kg/m ² ; Construction WGR: 73.9 kg/m ²	Demonstrated benefits of reusing concrete (lower carbon footprint)
2022–2023	Bangladesh (6 cities)	3.71 million tons	Major components: concrete, brick, plaster, steel	National recycling rate < 10% (mostly informal sector)

5. Interpretation and Discussion of Findings

This section interprets the financial impact matrix of climate hazards on Bangladesh’s SMSPs over the 2005–2025 period, synthesizing the dataset findings with validated secondary sources. The evidence reveals that floods remain the most frequent and cost-intensive hazard for construction projects—an observation consistent with World Bank assessments of multi-billion-dollar damages from Bangladesh’s recurrent hydrometeorological events (Chowdhury et al., 2021). Cyclones such as Sidr (2007) and Amphan (2020) caused catastrophic damage, particularly in coastal divisions like Khulna and Barisal. These findings align with official cyclone impact summaries (e.g., GFDRR’s report on Sidr (GFDRR, 2008)) and detailed documentation of Cyclone Amphan’s devastation (Chowdhury et al., 2021). The increasing frequency of severe flooding (notably 2014, 2022) coupled with extreme heatwaves (e.g., the record heat in 2024) indicates that compound hazard years are becoming more common and financially overwhelming (ReliefWeb, 2023; Christian Aid, 2019).

Labor-related productivity losses—particularly those observed during the 2024 heatwave—are corroborated by climate resilience studies that estimate significant construction-sector disruptions due to occupational heat stress (Climate Resilience Hub, 2022). In our dataset, extreme heat contributed roughly USD 1.2 billion in labor productivity losses, which validates models predicting a 5–7% decline in national productivity under intensifying warming scenarios. Project time overruns, commonly seen during major flood and cyclone years, expose systemic vulnerabilities in SMSP planning and response. Cost overruns driven by post-disaster material shortages and inflation (up to ~25% price surges in severe flood years) mirror broader national patterns of inflation and volatility in the wake of disasters (Grantham Research Institute, 2023). These losses are compounded by pre-existing issues like poor waste management and fragile material logistics chains, as noted in recent infrastructure resilience studies (Islam et al., 2023).

5.1 Major implications

The data trends above indicate several major implications for SMSP project management:

Resilience in Scheduling: SMSPs need to adopt robust early-warning systems and weather-adaptive scheduling, especially for construction activities planned in the monsoon months (ReliefWeb, 2023; Grantham Research Institute, 2023). Proactive schedule buffering and flexibility can help minimize delays due to sudden floods or storms.

Procurement Flexibility: Contractors should consider strategic stockpiling of key materials and implementing price-lock agreements during stable periods. Such measures would help mitigate inflationary pressures and material shortages in the aftermath of disasters (Chowdhury et al., 2021; Islam et al., 2023).

Heat Adaptation for Laborers: Enhanced on-site heat adaptation measures are necessary to protect workers and maintain productivity during extreme heat. Providing shaded rest areas, rotating crews in shorter shifts, and enforcing hydration and rest breaks in peak summer can substantially reduce heat stress losses (Climate Resilience Hub, 2022). Additionally, indirect losses often follow major floods and cyclones, including extended service disruptions, damage to temporary on-site facilities, and migration of laborers seeking alternative livelihoods. These indirect effects were evident after events like Cyclone Aila (2009) and Bulbul (2019), which led to prolonged recovery times for local construction activities (Kumar et al., 2020).

SMSP Contribution to Reducing Carbon Emissions: Beyond adapting to climate impacts, small- and medium-scale projects have a crucial role in mitigating climate change. By embracing sustainable construction practices—such as using low-carbon materials, improving energy efficiency on worksites, and recycling C&D waste—SMSPs can collectively reduce the construction sector’s carbon footprint. The findings suggest that wider adoption of green building techniques and materials recycling in SMSPs could significantly cut down greenhouse gas emissions associated with construction. This potential for carbon reduction is especially important in Bangladesh’s context, where thousands of SMSPs, though individually modest in scale, cumulatively contribute substantially to resource consumption and emissions. Encouraging and incentivizing SMSPs to implement renewable energy (e.g. solar-powered equipment), efficient logistics, and waste recycling not only helps the environment but can also lower long-term project costs. Therefore, climate change initiatives in the construction sector should explicitly include SMSPs as agents of change in moving toward a low-carbon, sustainable future.

5.2 Limitations and forward directions

This analysis is based on secondary data and institutional estimates, which imposes certain limitations. District-level resolution of the impact data is limited, and many loss estimates rely on macroeconomic modeling rather than detailed project-level logs from contractors. Future research should strive to incorporate the following to build on our findings: **Longitudinal Tracking:** Conduct longitudinal tracking of SMSP performance during and after disaster events to observe recovery trajectories and long-term impacts on project outcomes.

Geospatial Analysis: Utilize geospatial analyses overlaying hazard exposure maps with the locations of project delays and losses to identify geographic hotspots of climate vulnerability.

Integrated Data Systems: Integrate climate anomaly datasets (e.g., granular rainfall intensity records, soil salinity maps, temperature extremes) into project management tools for adaptive planning.

By addressing these gaps, future studies can provide more actionable insights and localized strategies for enhancing the climate resilience of small- and medium-scale construction projects.

6. Conclusion

Bangladesh’s small- and medium-scale construction projects have faced escalating risks from climate change over the past two decades. Evidence from 2005–2025 shows that recurrent floods, cyclones, and heatwaves have significantly disrupted infrastructure development, especially in low-lying and coastal regions. For example, Cyclone Sidr in 2007 caused over USD 1.7 billion in damages, and the extreme monsoon floods of 2014 and 2024 together led to losses exceeding USD 3.8 billion.

The financial impact matrix derived from secondary data highlights not only direct infrastructure damage but also serious indirect impacts—such as labor productivity declines, prolonged project delays, and spiraling costs—that underscore the construction sector’s vulnerability to climate stressors. Notably, the heatwave of 2024 alone was estimated to cause USD 1.2 billion in lost productivity in the construction sector due to reduced labor efficiency in extreme temperatures.

To counteract these challenges, the construction industry must pivot toward digital, climate-resilient project management. This includes integrating predictive weather analytics into project scheduling, adopting flexible

procurement and contracting mechanisms to absorb price shocks, and implementing comprehensive labor safety and wellness protocols (e.g., staggered shifts, on-site cooling/hydration stations) during extreme weather. Such reforms are particularly critical for SMSPs, which often operate informally with limited access to climate finance or advanced planning tools.

On a policy level, greater support for SMSPs is needed. This could involve incorporating localized hazard forecasts into urban planning and building code guidelines, promoting risk-sharing arrangements in construction supply chains, and providing incentives for using sustainable, climate-friendly construction materials. Without these interventions, the escalating costs of climate inaction in the construction industry may severely undermine Bangladesh's broader development goals. Proactively strengthening the resilience of SMSPs will not only protect infrastructure investments but also safeguard livelihoods and foster sustainable growth in the face of climate change.

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Biographies

Lailo Akter (1st Author & Primary Presenter) is a first-year B.Sc. Civil Engineering student at the World University of Bangladesh, recognized for becoming a First Author at a very early academic stage. Her early research engagement demonstrates strong initiative, academic maturity, and a growing interest in civil engineering research. She served as a Reviewer for technical papers at the 8th IEOM Bangladesh Conference (Dhaka, 2025) and is also listed as a member of the IEOM Technical Committee, reflecting her emerging professional credibility. Before starting her B.Sc., Lailo completed a four-year Diploma in Civil Engineering with distinction. Her academic and professional interests include structural engineering, construction engineering, materials engineering, and environmental engineering. She continues to develop practical expertise through competitions, project-based learning, and an internship at Bangladesh Engineering Consultants, where she gained hands-on industry experience. Skilled in AutoCAD architectural planning and structural detailing, Lailo combines academic excellence, practical competence, and early research leadership—positioning her as a promising young scholar in the field.

Shahla Shumi is an undergraduate student pursuing a B.Sc. in Civil Engineering at the World University of Bangladesh. She holds a four-year Diploma in Civil Engineering and has professional experience as a Quality Assurance Engineer at VCube Soft & Tech. As the second author of this review paper, she demonstrates a strong foundation in both industry quality standards and academic research. Shumi is currently enhancing her technical skills through the IsDB-BISEW IT Scholarship Program, specializing in A-CAD applications. She is deeply interested in structural analysis and the process of rebuilding and restoring existing infrastructure.

Md. Razu Ahmmed is a final-year Civil Engineering student at the World University of Bangladesh. He maintains a strong academic record and values professional integrity. His academic experience includes coursework, laboratory practice, field observation, and project-based learning, which have strengthened his analytical and problem-solving abilities. His research interests include transportation engineering, sustainable infrastructure, pavement materials, and modern construction technologies. He is particularly focused on improving the efficiency, safety, and durability of engineering systems through sustainable and innovative design approaches. Razu aims to contribute effectively to engineering organizations through skills in planning, design, analysis, and project coordination, while continuously adopting modern engineering tools to meet emerging industry challenges.

Abu Talha is a final-year Civil Engineering student at the World University of Bangladesh. His research focuses on climate-resilient construction and project management. Experience includes community and environmental development aligned with SDGs at World Vision Bangladesh, research with CARO, and project-based interior design work.