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PROJECT MANAGEMENT AS AN ENABLER OF GREEN CONSTRUCTION FOR CLIMATE CHANGE MITIGATION IN PAKISTAN: A SYSTEMATIC REVIEW

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Abstract

Construction and buildings are responsible for roughly 37% of global energy-related carbon dioxide emissions. Pakistan is one of the world's most climate-vulnerable countries, experiencing rapid growth in its building stock, primarily constructed with energy-intensive traditional methods. Despite being recognized as an important mitigation avenue, green construction remains nascent in Pakistan, and the moderating role of project management in climate mitigation outcomes has been largely overlooked in the domestic literature. This research fills that knowledge gap by synthesizing the findings on the moderating effects of project management practices on the climate-mitigation outcomes of green construction in the country. We undertook a systematic review of the literature, following PRISMA guidelines. We searched Scopus, Web of Science, ScienceDirect and Google Scholar databases for 318 records published from 2014 to 2025. Duplicates were removed, and the studies were screened, reviewed and appraised for quality, leaving 42 included studies. We also included grey literature from the United Nations Environment Program, the Intergovernmental Panel on Climate Change, the Government of Pakistan, the Rocky Mountain Institute and the Pakistan Green Building Council. An analysis of themes was undertaken using the project-management life cycle: planning, procurement, execution and monitoring. Practices of green building, when coordinated through structured project management, may achieve operational carbon reductions of 20-35%, embodied carbon reductions of 20-45%, water savings of 30-40% and construction-waste reduction of 30-50%. But these results are systematically weakened when sustainability is added to designs, rather than being integrated as a project goal. Setting environmental performance targets at the project-planning stage, green procurement rules favoring low-carbon inputs, environmental monitoring on site, and environmental performance review during post-occupancy assessment are the four most effective project-management factors. This paper is the first Pakistan-specific review that considers project management as a moderating factor. It offers an integrated model of project-management impacts on climate-mitigation and a series of evidence-based policy, practice and industry

recommendations for policymakers, professional bodies and construction companies.

1. INTRODUCTION

The world is amid a climate crisis, and the buildings and construction sector is now front and Centre of the global mitigation effort. The 2022 Global Status Report for Buildings and Construction estimate the sector is responsible for around 37% of global energy-related carbon dioxide emissions and 34% of global energy demand - the highest of any sector (United Nations Environment Programme, 2023a). These emissions are divided between the operational uses of buildings (heating, cooling, lighting and plugs) and the embodied emissions of the production, transport and installation of building materials like cement, steel and aluminum (Rocky Mountain Institute, 2021; Mirasgedis et al., 2024). As operational efficiency rises in line with more stringent energy codes and decarbonising electricity grids, embodied emissions are projected to make up over half of the lifetime emissions of new buildings built today and in the coming decades until 2050 (United Nations Environment Programme, 2023b; World Green Building Council, 2019).

Pakistan is a prime example of this global trend. Pakistan is ranked among the ten countries most vulnerable to climate change despite accounting for less than 1% of global greenhouse gas emissions (Khan et al., 2021; Government of Pakistan, 2025). Floods in 2010, 2022 and 2024, recent heatwaves in Karachi and Jacobabad, and the rapid rate of glacial melt in the Hindu Kush-Karakoram-Himalaya ranges have combined to displace millions of people and cause aggregate damages of more than thirty billion United States dollars (World Bank, 2022). Meanwhile, urbanisation (with approximately 40% of the population now living in cities, and an expectation to reach 50% by 2030) is increasing the need for residential, commercial and infrastructure development (Government of Pakistan, 2025).

In this context, green building - which includes energy-efficient design and materials, waste and water reduction, and renewable-energy integration - has been proposed globally as a holistic solution. International evidence shows that green buildings, when designed to maximise energy and material efficiency, can deliver between 20-35% reduction in operational energy and 20-45% reduction in embodied carbon, with no or small cost premiums (Kibert, 2016; Rocky Mountain Institute, 2021; United Nations Environment Programme, 2023a). However, in Pakistan, implementation remains limited. Less than three percent of new commercial building projects and less than one percent of new residential projects feature formally documented green-building features, and green-building certification is limited to a narrow band of corporate, banking and diplomatic projects in Karachi, Lahore and Islamabad (Hussain et al., 2025; Majid & Khan, 2021).

Pakistani research on this topic has tended to focus on three topics: awareness among construction stakeholders, barriers to adoption, and technical prescriptions (Azeem et al., 2017; Siddiqui et al., 2025; Hussain, Waleed, et al., 2025). Much less attention has been taken to a fourth and arguably more significant question: having decided to go "green", what factors determine whether a project's climate-mitigation potential is realized? Global literature is increasingly identifying project management as the key moderating variable (Silvius & Schipper, 2014; Abid et al., 2025; Kissi et al., 2025). In Pakistan, this variable has received little attention in the published literature.

This paper seeks to redress this oversight. It reviews the Pakistani and other developing-world evidence to address the following three questions: (RQ1) What outcomes in terms of climate change mitigation have been reported for green construction in Pakistan and elsewhere? (RQ2) What project-management practices (planning, procurement, implementation and monitoring) are linked with better mitigation outcomes? (RQ3) What policy and institutional factors must be in place to enable these project-management practices to scale across the construction industry in Pakistan? The paper structures the evidence

around project-management practices to provide an analytical and practical starting point for construction firms, governments and professional bodies in Pakistan.

The rest of the paper is structured as follows. Section 2 reviews literature and the conceptual basis of sustainability-focused project management for improved green-construction climate outcomes. Section 3 outlines the systematic-review process. Section 4 presents the results and discusses their relevance to Pakistan. Section 5 concludes and provides recommendations for policy, practice and future research.

2. LITERATURE REVIEW

This paper's conceptual foundation brings together two bodies of literature. The first is the sustainable-construction literature, most comprehensively defined by Kibert (2016), which underpins green-construction practices through five principles: resource efficiency, energy efficiency, pollution prevention, environmental harmony and life-cycle thinking. The second is the sustainability-in-project-management literature, the key work of which is Silvius and Schipper (2014). Silvius and Schipper contend that incorporating sustainability into project management broadens the traditional "iron triangle" of time, cost and scope to include environmental, social and economic aspects and that this must be done across the project's life cycle (from initiation and planning through procurement, execution, monitoring and close-out).

The crossroads of these two bodies of literature lead to a simple but little-developed proposition. Green-construction technologies - such as low-carbon concrete, high-performance building envelopes or rooftop photovoltaic installations - can only provide climate-related benefits if they are properly specified, procured, installed, commissioned and operated. All these tasks are project management's responsibility. When project management considers environmental performance as a primary goal, green-construction technologies typically perform as designed or close to their potential. Where project management relegates environmental performance to a compliance issue, the gap between design and operational performance increases and the full mitigation potential is not realized (Silvius & Schipper, 2014; Mirasgedis et al., 2024).

Informed by the above, this paper postulates project management as a moderator in the link between green construction practices (independent variable) and climate-mitigation effects (dependent variable). This moderating role is realized through four loci of project-management practice: (a) planning, in which environmental key performance indicators are established; (b) procurement, in which low-carbon suppliers and assured environmental product declarations are favored; (c) execution, in which on-site environmental management plans and waste-tracking software are deployed; and (d) monitoring, in which the operational performance of constructed assets is measured against design intent. Each of these is supported by parallel work on green human-resource management (Kissi et al., 2025), green training (Warıs & Ulku, 2023) and culture in sustainable construction (Abid et al., 2025). Figure 1 presents the conceptual research model adopted in this study.

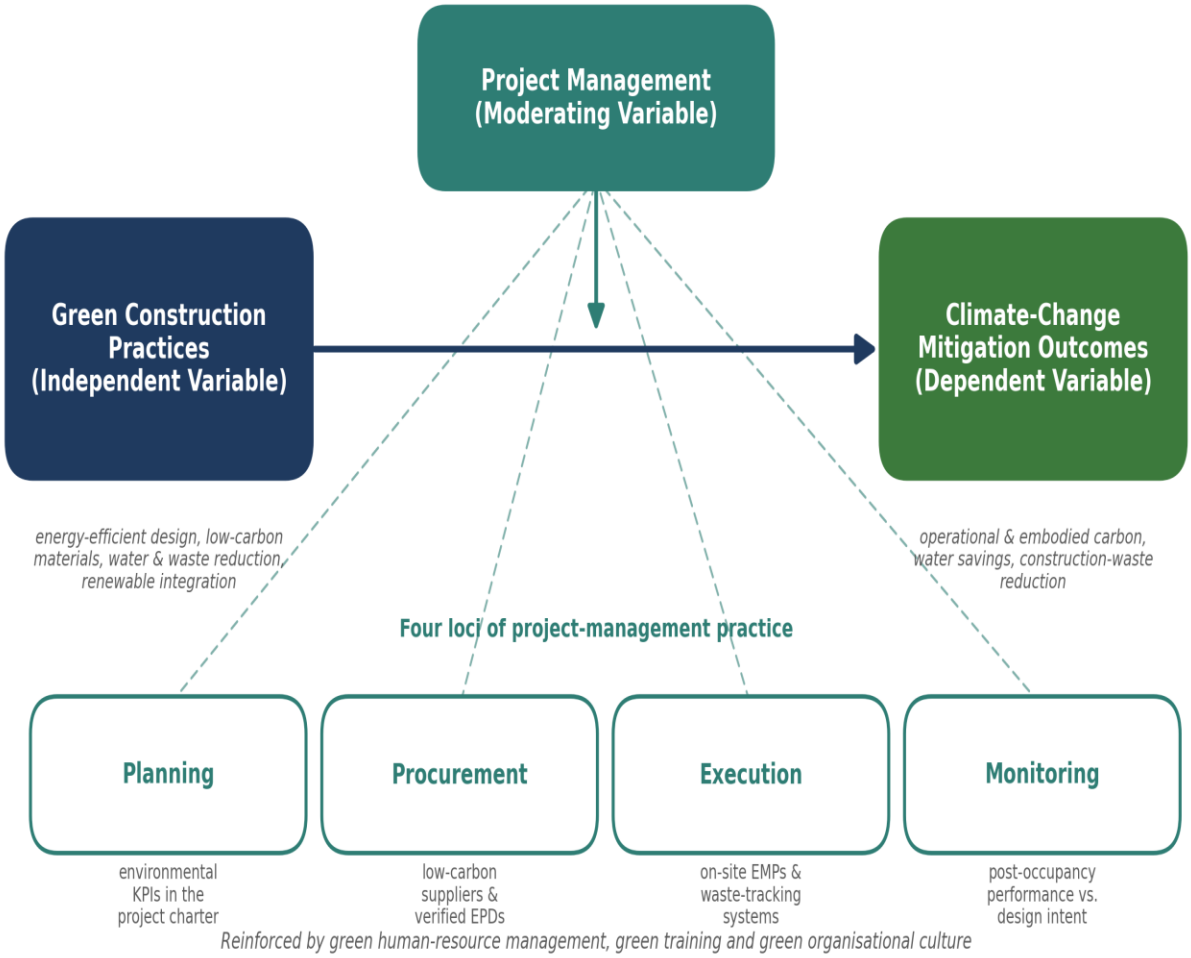


Figure 1. ***Conceptual research model: project management as a moderator of the relationship between green-construction practices and climate-change mitigation outcomes.***

This approach is incorporated in the thematic analysis below. It enables the paper to separate the technical effectiveness of green-construction measures (which is reasonably well known) from the institutional and managerial conditions that enable their effectiveness (which is not as well known in the case of Pakistan).

3. RESEARCH METHODOLOGY

3.1 Research mode

The research mode of this study is qualitative and interpretive, operating within a secondary-research paradigm. Rather than generating new primary data, the study interrogates, synthesis and re-interprets an existing body of published evidence to build an integrated understanding of how project management moderates the climate-mitigation outcomes of green construction. The mode of reasoning is primarily inductive: themes are developed from the evidence itself rather than tested against a pre-specified hypothesis, although the synthesis is organized through the conceptual lens of the project-management life cycle. This mode is appropriate to the research questions,

which are explanatory and exploratory in nature, and which seek to make sense of a fragmented and largely qualitative evidence base in a context — Pakistan — where primary performance data remain scarce (Mingyi et al., 2024; Silvius & Schipper, 2014).

3.2 Research design

This study adopts a systematic literature review (SLR) design, conducted in accordance with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA 2020) statement to ensure transparency, rigor and reproducibility. An SLR was selected over a narrative review because the research questions concern an evidence base that is fragmented across disciplines (engineering, management and policy), draws on heterogeneous study designs (empirical surveys, case studies, simulations and policy analyses), and carries a strong practice and policy orientation (Mingyi et al., 2024; Mirasgedis et al., 2024). The review followed four sequential phases, mirroring the PRISMA flow: identification of records through databases and supplementary searching; screening of titles and abstracts against the eligibility criteria; assessment of full-text articles for eligibility; and inclusion of studies in the thematic synthesis. To strengthen reliability, the protocol — covering the search strings, databases, inclusion and exclusion criteria, and the quality-appraisal instrument — was defined in advance of the formal search, although it was not registered in a public registry such as PROSPERO; this limitation is acknowledged in Section 4.9.

3.3 Search strategy

Systematic search was carried out between June and September 2025 across four bibliographic databases selected for their complementary coverage of engineering, management and multidisciplinary literature: Scopus, Web of Science, ScienceDirect and Google Scholar. The search was restricted to records published between January 2014 and 2025; the 2014 lower bound was chosen to coincide with the publication of the foundational work of Silvius and Schipper (2014) on sustainability in project management, which marks the emergence of the conceptual lens applied in this review. Search strings were constructed from three concept clusters combined with the Boolean operator AND, with synonyms within each cluster combined using OR: (a) green-construction terms ("green building", "sustainable construction", "green construction practices", "low-carbon buildings"); (b) climate-change terms ("climate change mitigation", "carbon emissions", "embodied carbon", "greenhouse gas"); and (c) geographic and thematic terms ("Pakistan", "South Asia", "developing countries", "project management", "sustainability"). The strings were adapted to the field-tag and truncation syntax of each database. The database search was supplemented by hand-searching the most relevant journals and by backward reference-list scanning (snowballing) of included studies to capture records not indexed under the search terms. Authoritative grey literature was deliberately included, given the policy-oriented nature of the research and the publication lag in a rapidly evolving regulatory environment; sources comprised reports of the United Nations Environment Programme, the Intergovernmental Panel on Climate Change, the Rocky Mountain Institute, the World Green Building Council, the World Bank, the National Energy Efficiency and Conservation Authority and the Pakistan Green Building Council.

3.4 Inclusion and exclusion criteria

Eligibility was assessed against pre-defined inclusion and exclusion criteria. Studies were included if they: (a) were published in English in a peer-reviewed journal, in a technical report issued by a government department or other authoritative institution, or in an institutional policy document; (b) addressed green-construction practices, climate-change mitigation in the built environment, or the project management of sustainability; (c) reported empirical evidence, constituted a systematic review, or offered a conceptually robust analysis; and (d) were available in full text. Studies were excluded if they were opinion or editorial pieces lacking supporting evidence, conference papers not subsequently developed into full articles, purely engineering-optimization studies with no sustainability or

mitigation dimension or works addressing contexts with no transferable relevance to Pakistan. Where the same study was reported across multiple outputs, the most complete peer-reviewed version was retained to avoid double counting.

3.5 Screening and quality appraisal

The database and supplementary searches identified 318 records. After the removal of duplicates, 241 records proceeded to title-and-abstract screening against the eligibility criteria, at which stage clearly irrelevant records were removed. The remaining 118 records were retrieved in full and assessed for eligibility, of which 71 were excluded for failing to meet one or more inclusion criteria. The 47 studies that passed full-text screening were then subjected to a structured quality appraisal. The appraisal instrument scored each study on four dimensions — clarity of the research aim and method, relevance to the review questions, strength and credibility of the evidence, and transparency of reporting — with each dimension rated on a three-point scale and studies falling below a minimum threshold excluded. Five studies that had passed full-text screening were removed at this stage on quality grounds, yielding a final corpus of 42 studies retained for thematic synthesis. The final selection comprises international peer-reviewed publications, Pakistan-focused empirical research and high-quality grey literature, providing a balance between global evidence and country-specific applicability. The complete screening process is summarized in Table 1.

Table 1. ***PRISMA-aligned screening summary***

Stage	Records
Records identified through database searches	318
Records after duplicate removal	241
Records screened (title – abstract)	241
Full-text articles assessed for eligibility	118
Studies excluded at full-text stage	71
Studies excluded at quality appraisal	5
Studies retained for thematic synthesis	**42**

3.6 Data analysis

We analyzed the retained corpus thematically following a six-step process: (i) becoming familiar with the corpus; (ii) coding of extracts relevant to the research questions; (iii) grouping codes into potential themes; (iv) reviewing and refining themes; (v) defining final themes; and (vi) synthesizing. Coding was done in a narrative spreadsheet, structured according to the four key loci of project management (planning, procurement, execution, monitoring) and verified against the primary sources. This yielded five major themes: (i) reported climate-mitigation outcomes; (ii) project-planning processes; (iii) green procurement; (iv) implementation and monitoring; and (v) barriers and enablers. These themes are reported in Section 4.

3.7 Ethical considerations

As the study is a secondary analysis of data collected from publicly available sources, there are no ethical considerations associated with human-participant research. The study upholds scholarly-integrity standards. Citations have been done according to APA 7th edition standards, and paraphrasing has been done in a way so as to not

misrepresent the authors' original ideas. The study adheres to The Superior University Lahore's ethical guidelines.

4. RESULTS AND DISCUSSION

4.1 Climate-mitigation outcomes of green construction

The evidence we retained shows a consistent set of outcomes for green-construction practices in Pakistan and similar contexts. Hussain et al. (2025) observe that commercial buildings designed with the Energy Conservation Building Code 2023 can achieve thirty to thirty-five percent operational-energy savings compared to the baseline practice in the same climatic zone. Hussain, Waleed, et al. (2025) report that replacing fired-clay bricks with compressed stabilized earth blocks or fly-ash bricks lowers the embodied-carbon intensity of the material by forty to sixty percent with similar performance. Ali et al. (2024) report similar opportunities for reduction from the use of rice husk ash (an agricultural byproduct in Pakistan) in concrete. Alvi and Mudassar (2025) show that widespread implementation of rooftop PV arrays at the building scale could substantially reduce net electricity imports, and fossil fuel emissions at scale.

These Pakistan studies are a confirmation to the global evidence. Meta analysis of studies of the life cycle of whole buildings from Rocky Mountain Institute (2021) show embodied-carbon savings from 20% to 45% in green certified buildings, and in some cases costs that are either negligible or negative. The typical amount of savings in operational energy for certified green buildings ranges from 20% to 30% (United Nations Environment Programme 2023a), depending on the climate zone and occupancy profile. Sajid et al. (2024) found that using modular construction as a mitigation measure can result in embodied-carbon reductions ranging from 25 to 40 per cent, and waste-reduction savings of 35 to 50 per cent when compared with in-situ construction. The other advantages are also significant: In similar climates, green buildings require a saving of potable water of 30-40 per cent through the use of low flow water fittings, rainwater harvesting and greywater recycling, and significantly less waste is generated (Siddiqui et al., 2025); the buildings are also important contributors to urban heat-island mitigation and storm water management (Mumtaz, 2024). But the evidence also suggests a continuing 'performance gap'. A number of global studies have demonstrated that certification and operational performance are not necessarily linked; lower certification levels in particular are not necessarily more energy efficient (in terms of source energy) than their conventional peers (United Nations Environment Programme, 2023a; Mirasgedis et al., 2024). This is key to the project-management argument below.

4.2 Project planning: climate performance in project charters

The evidence pinpoints project planning as the most critical project-management intervention. Abid et al. (2025) demonstrate that Pakistani construction companies that embed environmental performance targets into project charters are much more likely to achieve project delivery within sustainability limits than companies that consider sustainability a compliance exercise. These targets often manifest as quantified key performance indicators - kilograms of CO_2 equivalent per square meter, percentage of construction waste diverted from landfill, on-site renewable-energy capacity, potable-water consumption per occupant - that are enshrined in the project logical framework and tracked during project delivery.

The rationale for such an emphasis is laid out in Silvius and Schipper (2014), who view sustainability as a fundamental transformation of project goals; therefore, it needs to be incorporated at the project-initiation stage, not tacked on later in the delivery process. The empirical evidence is provided by Mingyi et al. (2024), whose systematic review finds sustainable-project-management skills to be among the most powerful predictors of green-building success in the Asia-Pacific. Najafi and Rahimian (2024) also conclude that climate-responsive design is not a technological tweak to the status quo of conventional construction but rather a paradigm

shift in project delivery, which begins with project scoping and planning.

This has big implications for Pakistan. Sustainability KPIs are not commonly part of project charters in Pakistan and project-management practice is typically driven by low-price tendering and contract-bid-based delivery under non-environmental-focused frameworks (Majid & Khan, 2021; Azeem et al., 2017). When sustainability targets are incorporated, they often relate to compliance with the dust and noise regulations, rather than to actual mitigation of effects. So, improving the incorporation of environmental KPIs into the project charters through both an amendment of procurement regulations and training of project managers becomes a crucial intervention.

4.3 Green procurement: specifications and supplier selection

The second key project-management lever is procurement. The evidence from case studies by the Rocky Mountain Institute is that procurement practices that specify low-carbon materials, localized inputs and suppliers with verified environmental product declarations (EPDs) can deliver a twenty-to forty-five per cent reduction in embodied carbon at no or low-cost premium (Rocky Mountain Institute, 2021). This conclusion is supported by the international literature on low-carbon concrete procurement, use of high-recycled-content steel, and substitution of virgin aluminum with products from factories powered by low-carbon electricity (United Nations Environment Programme, 2023b; World Green Building Council, 2019).

In Pakistan, the procurement environment is a major barrier to implementing these practices. Public procurement is also very largely regulated by the Public Procurement Regulatory Authority and provincial procurement regulations, which favor low evaluated bid as the primary award criterion. Azeem et al. (2017) and Majid and Khan (2021) observe that environmental factors are not weighted and monitored on tenders. Private-sector procurement is often governed by very short-term investor time horizons that value more on short payback periods. The lack of a verified local EPD system also makes it difficult for firms to specify the use of low-carbon materials, as they must either adopt international EPDs without knowing their validity in a Pakistani context or rely on supplier claims that are not independently verified (Hussain, Waleed, et al., 2025).

The development of a local low-carbon materials supply chain - enabled by the National Energy Efficiency and Conservation Authority's Energy Conservation Building Code 2023, a draft Pakistan Green Building Code and pilot projects under the Pakistan Green Building Council - provides an opportunity (National Energy Efficiency and Conservation Authority, 2023; Pakistan Green Building Council, 2022). But the growth of this supply chain will be dependent on a procurement framework that incentivizes suppliers for undertaking the measurement and verification of environmental information. This is the subject of the paper recommendations in Section 5.

4.4 Execution and monitoring: environmental management on site

Project-management lever three relates to execution and monitoring. The critical elements of green-construction execution include environmental management plans for site operations, waste-management systems and real-time monitoring of key performance indicators. Kissi et al. (2025) provide empirical evidence of a direct relationship between green human-resource management (training, sustainability-based incentives and environmental performance assessment) and the environmental outcomes of construction projects. Organizations adopting these practices in their human-resource management systems outperform their counterparts.

Warıs and Ulku (2023) offer corroborating evidence on the role of green training in improving corporate sustainable performance in the construction industry, although the magnitude of this impact is contingent on the presence of complementary management practices that help surmount implementation challenges. Abid et al. (2025) highlights organizational culture: firms with a strong "green culture" are

more likely to have strong risk- and crisis-management procedures aimed at sustainable action. These results suggest that performance outcomes in the execution phases are not determined by technical controls but by the organizational and human-resource systems in which they operate.

Monitoring is also equally important. The international literature consistently and usually reports a "performance gap" between design and operational performance (United Nations Environment Programme, 2023) which can be significantly decreased through comprehensive commissioning, user training and post-occupancy performance evaluation. In Pakistan, post-occupancy evaluation is not yet very common, except for a handful of LEED-certified projects with multinational corporate and private sector owners. Making post-occupancy evaluation an integral part of the project management process - rather than a niche consultancy service to be purchased as an add-on - would complete a major gap in the existing project-management system.

4.5 Challenges of integrated project management for green construction

The fifth theme brings together the reasons why the systematic use of sustainability-focused project management in Pakistan is hampered. The findings are very consistent with the evidence from similar developing countries but also exhibit country-specific characteristics.

Five categories of barrier emerge;

Economic barriers include perceptions of premiums on upfront cost (often estimated by the developers as 10-20% but evidence suggests that zero to five percent for common green measures) (Rocky Mountain Institute, 2021). Azeem et al. (2017) and Majid and Khan (2021) note the perception gap and its impact on uptake. Green finance is in development, but not to the extent needed (Alvi & Mudassar, 2025).

Institutional barriers include the lack of a binding national code on green buildings, lack of enforcement of the existing provincial building codes, lack of integration between the federal, provincial and municipal governments, and lack of integration of sustainability into procurement law (Majid & Khan, 2021; Climate Technology Centre and Network, 2018). The draft Pakistan Green Building Code and Energy Conservation Building Code 2023 offer technical guidance but lack mandatory enforcement jurisdictions (National Energy Efficiency and Conservation Authority, 2023; Pakistan Green Building Council, 2022).

Technical barriers include lack of local availability of some green materials, immature supply chains for large-scale use of supplementary cementitious materials, lack of accredited green-building professionals, and lack of knowledge of building-energy simulation tools (Hussain, Waleed, et al., 2025; Siddiqui et al., 2025).

Socio-cultural factors include client rejection of new technologies, concern about green-building durability and aesthetics, and inertia in the industry. Siddiqui et al. (2025), using the Theory of Planned Behavior, confirm that subjective norms (what others are perceived to be doing) have a significant impact on the adoption intention of Pakistani construction professionals, often greater than attitude. This suggests the need for visible demonstration projects and industry leaders.

Information constraints consist of the lack of data on performance in Pakistan, weakness in post-occupancy monitoring, and lack of sharing of best-practice examples. These contribute to a view that green construction is untested or unsuitable for the Pakistani context and to a lack of a strong business case that procurement teams can build to support a premium price for green specifications (Mumtaz, 2024; Rasheed et al., 2023).

On the enabling side, the evidence reveals a number of common factors: client demand (usually from multinational corporations or educational institutions with sustainability policies); effective project-management leadership that prioritizes sustainability; working with international technical experts; and growing access to green finance via instruments such as green sukuks and sustainability loans (Alvi & Mudassar, 2025; Government of Pakistan, 2025). These factors point clearly to the set of policy and practice levers in the next section.

4.6 An integrated framework for project management in green construction

The five themes justify the integrated approach. Green-construction technologies can only deliver their climate-theory-based benefits when (a) planning incorporates quantified environmental KPIs in the project charter; (b) procurement specifies and verifies low-carbon inputs; (c) execution is supported by green human-resource management, training and environmental management systems; and (d) monitoring ensures that operational performance meets design intent, with lessons learned feeding into practice. These four elements are mutually reinforcing. Failure in one weakens the effectiveness of the others, while integration of the four multiplies the impact of individual mitigation measures into synergies.

The framework helps to explain a common finding in the Pakistani literature: that adopting green technologies and achieving mitigation performance are not the same. A project might include high-performance windows and roof-mounted photovoltaics but still perform poorly because the project specifications were watered down by value-engineering practices, because its commissioning was cursory, or because it was not subject to a post-occupancy review. In contrast, even simple technology packages can perform exceptionally well when properly integrated by good project management. This observation is in line with the perspective of Silvius and Schipper (2014) that integrating sustainability is a project-management challenge, and with the more recent empirical findings of Kissi et al. (2025) and Abid et al. (2025).

4.7 Policy implications for Pakistan

There are several policy implications. First, the upgrade of the Pakistan Green Building Code and the Energy Conservation Building Code 2023 to mandatory national standards - with transparent phase-out plan and sufficient staff for enforcement - would create a better institutional setting for project managers (National Energy Efficiency and Conservation Authority, 2023; Pakistan Green Building Council, 2022). Second, the reform of public procurement regulations to give weight to environmental considerations (rather than lowest evaluated bid) would create a systemic demand for low-carbon products and encourage suppliers to develop environmental product declarations. Third, targeted tax measures - such as exemptions from sales tax on supplementary cementitious materials and high-efficiency equipment, and favorable net-metering tariffs for building-integrated photovoltaic systems - would reduce the perceived cost premium that constrains adoption (Alvi & Mudassar, 2025; Government of Pakistan, 2025).

Fourth, the adoption of sustainable building principles in all public-sector building projects - schools, hospitals and government offices - would leverage the public estate as a showcase and training ground. International experience in similar circumstances suggests that public-sector demonstration is a very effective pathway to market transformation (United Nations Environment Programme, 2023a; World Green Building Council, 2019). Fifth, Pakistan's increasing access to international climate finance from the Green Climate Fund, carbon markets and green (sustainability-linked) finance provide opportunities to fund green retrofits of the existing public-sector building stock (Government of Pakistan, 2025).

4.8 Lessons for project management

The paper has implications for the project-management profession in Pakistan, too. Project-management skills should include sustainability. The curriculum of continuing-education courses offered by the local branch of the Project Management Institute, as well as graduate courses in universities, should include modules on environmental KPIs, life-cycle assessment, green procurement and post-occupancy evaluation. Green-building certifications, such as the LEED Green Associate and the new certifications offered by the Pakistan Green Building Council, should be encouraged. Firms should be encouraged, and if working on public-sector projects, mandated, to ensure that project teams for projects of a certain value include certified green-building professionals.

At the organizational level, embedding environmental performance in human-resource

management processes, including recruitment, training, appraisal and incentives, appears as a key lever (Kissi et al., 2025; Warıs & Ulku, 2023). Cultural change (Abid et al. 2025) cannot be implemented through training programs alone, but requires consistent leadership and management commitment, visible accountability for environmental performance and the institutionalization of environmental considerations in project reviews.

4.9 Limitations

This research has some limitations. First, SLR is dependent on the quality and extent of the existing literature; the body of evidence in Pakistan is relatively limited and, for some quantitative estimates, international data have been used. Second, the literature review was limited to English-language sources; it may have missed Urdu or regional language sources. Third, the paper does not produce primary quantitative data; the quantitative estimates produced should be considered as approximate. Fourth, given the rapid pace of change in Pakistan's energy and climate policy space, some of the regulatory details may change between submission and publication. The SLR was also not pre-registered, another recognized issue with SLRs.

5. CONCLUSION AND RECOMMENDATIONS

This paper has shown that the climate change mitigation benefits of green construction in Pakistan depend on the project management of the construction process. The paper has demonstrated that, with systematic integration in project management, green-construction practices can reduce operational carbon by 20-35%, embodied carbon by 20-45%, water consumption by 30-40% and construction waste by 30-50%, through a systematic review of 42 peer-reviewed journal articles and a comprehensive collection of authoritative grey-literature sources. When project management simply pays "lip service" to sustainability, much of this potential is lost through specification drift, deficient commissioning and missing post-occupancy evaluation.

Four project-management levers stand out: the integration of environmental key performance indicators in project charters; green construction procurement rules specifying and measuring low-carbon inputs; site environmental management, underpinned by green human-resource practices; and post-occupancy performance review, which bridges the design–operation gap. The policy-intervention agenda, including the elevation of the Pakistan Green Building Code and Energy Conservation Building Code 2023 to mandatory national standards, the integration of environmental requirements into procurement and targeted fiscal incentives, can greatly improve the institutional context for the levers. The areas of professional and organizational culture complement policy reform as a critical focus.

Primary empirical studies of operational performance of Pakistani green buildings across different climate zones; life-cycle cost analysis based on Pakistani cost data; studies on the interaction between mitigation and adaptation in flood-prone and heat-stricken districts; and Pakistan-specific competency frameworks for sustainable-focused project management are the most important research priorities. This will gradually replace the international estimates of performance cited in this paper with local data, deepen the business case for scaling-up and help transform Pakistani green construction from a niche urban sector into a mainstream national climate strategy.

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