

DEVELOPING POLICY AND PRACTICE PATHWAYS FOR SUSTAINABLE CONSTRUCTION IN PAKISTAN

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ABSTRACT

Green building practices offer promising solutions to environmental degradation and resource inefficiency, yet their adoption in Pakistan remains limited due to persistent multiple diverse barriers. This paper examines the key deterrents to the adoption of green construction and aims to suggest recommendations with local capacity. Qualitative research design was employed to collect data through semi structured as well as unstructured interviews with stakeholders in the construction and green material supply chain industry, such as contractors, architects, designers, suppliers and sustainability experts. The MAXQDA thematic analysis used to identify barriers towards green building construction, to investigate mitigation measures through locally available resources for green construction, adopting integrated traditional design strategies for construction and motivating customers through key features of green buildings. Based on findings, it was observed that most of barriers were cost related as discussed in previous literature. The present study disintegrates the cost related barriers for rigorous analysis. The disintegration of cost barriers helps to suggest practical policy recommendations to mitigate cost barriers. The results indicate that the match between green design and local material innovation and policy reform can improve affordability and adoption.

Keywords: green building construction, green material supply chain, green construction barriers, green construction materials, green construction competencies, sustainable environment through green construction

INTRODUCTION

Like other developing economies, the construction industry in Pakistan is a determining driver of economic growth. Since 2021, it has surpassed the agricultural sector in its contribution to industry value-added, accounting for 13.4% (Asghar, Tanzeel et al. 2024). In a developing country, massive construction is required for developmental activities including transportation, real estate, market hubs, dams etc.

including, these activities include material extraction, demolition, waste generation and habitat destruction by diverting natural flow of rivers, deforestation and massive deep digging. Collectively, such practices have led to severe environmental degradation (Cucoş and Turcan 2025). The negative impact is further exacerbated by high energy consumption, limited recycling

practices, and substantial carbon emissions (Liu, Qin et al. 2025).

Green Construction, rooted in ancient climate-responsive designs using natural materials, gained momentum during the 1970s energy crisis as a modern repose to the environmental costs of urbanization and industrialization (EMaghwry and SEDHOM 2025). Globally, the concept of green buildings has gained increasing recognition to mitigate the adverse ecological impacts of construction, as it emphasizes sustainable processes, environmentally friendly materials, and energy efficiency (Almusaed, Yitmen et al. 2024). Whereas developing countries are still facing barriers in adoption of green buildings. Several studies across developing economies highlight that cost-related misperceptions remain a central barrier to the adoption of green buildings. For instance, a study in Nigeria identified seven main factors underlying cost misperceptions, including low knowledge of green building practices, unfamiliarity with performance metrics, inadequate evidence, poor risk perceptions, and reliance on the costs of exemplar projects (Ekung, Odesola et al. 2022). The authors attributed these findings to gaps in cost management, sustainability accounting, and professional knowledge, suggesting that improvements in these areas could significantly enhance cost perceptions and green building uptake.

Similarly, research conducted in Malaysia identified four critical barriers and four key strategies for green building adoption. Among these, two barriers – lack of availability of demonstration projects, and unfamiliarity with green building technologies (GBT) – and one strategy- educational programs for developers, contractors, and policymakers’- were common across organizational types (Termizi, Omer et al. 2024). These findings emphasize the importance of evidence-based demonstration and capacity-building initiatives in changing perceptions and practices.

Other reviews have focused on affordability and innovative approaches to sustainable construction. For example, Aung (2025) highlights the integration of locally sourced and recyclable materials, energy efficiency, and occupant well-being as viable means of reducing costs while

maintaining sustainability. Central to this perspective is the principal of ‘building with what is available’, which stresses the importance of accessible materials and adaptive design in lowering costs and carbon footprints. Case studies in this re-view illustrate how such strategies can democratize sustainable living and counter misconceptions about the high costs of green buildings (Aung, Htet et al. 2025).

In Iran, Gohari (2025) found that political and economic factors ranked as the most significant barriers to green building adoption, with ‘insufficient government incentives/supports’ and ‘high cost of sustainable projects’ receiving the highest priority. In contrast, social indicators were assigned the lowest importance, and ‘weakness in management’ was deemed least significant. The study suggested that governments could play a vital role in overcoming these barriers by providing loans, raising awareness, and offering more attractive incentives (Gohari, Gohari et al. 2025). Evidence from China also shows that investments in energy-efficient infrastructure, such as solar panels and insulation, can achieve payback within seven to ten years (Hamid, Romali et al. 2023). However, in other developing countries such as Nigeria or India, similar gains are often constrained by costly imported materials and the absence of effective policy incentives.

Another persistent challenge is the retrofitting of existing buildings. Soltani (2025) notes that the cost of upgrading old infrastructure to meet green building standards can exceed the expense of incorporating green features during new construction. This is particularly relevant in older urban centers in South Asia, where aging building stock dominates. As a result, many developers abandon retrofitting projects altogether, despite the potential environmental and social benefits (Soltani, Abbasnejad et al. 2025).

Similarly, in Pakistan, the widespread adoption of green buildings remains limited due to high initial cost of construction, that discourages contractors, developers, and clients from investing in sustainable technologies and materials (Azeem, Naeem et al. 2017). Green buildings are often associated with higher upfront expenses, due to the reliance on costly imported materials, advanced technologies, and specialized designs.

These financial barriers hinder stakeholders' interest, leaving the environment and economic benefits of green construction largely untapped (Hussain, Naqvi et al. 2025). Pakistan faces severe environmental challenges driven by rising energy consumption, pollution, and climate change. Despite the global momentum for green buildings and green building technologies, their adoption in Pakistan remains limited due to high costs, weak policies, lack of incentives, and low stakeholder awareness (Hussain, Naqvi et al. 2023). Although initiatives such as the Pakistan Green Building Council (PGBC) have created platforms for collaboration, the construction sector continues to rely heavily on unsustainable practices and fossil fuels, leading to inefficiencies and environmental damage (Tariq 2025).

Research shows that green building technologies include energy-efficient lighting, passive cooling, and building envelopes, can drastically reduce energy use, operational costs, and emissions, while improving indoor quality and resource efficiency. However, adoption remains slow, largely due to inadequate training, limited knowledge, and contextual barriers shaped by socio-economic and regulatory systems (Azeem, Naeem et al. 2017, Hussain, Naqvi et al. 2023, Hussain, Naqvi et al. 2025). As a result, the construction sector risks persisting in unsustainable practices that exacerbate resource depletion, urban pollution, and climate vulnerability.

One promising approach is the utilization of locally available materials. Indigenous resources such as bamboo, mud bricks, and clay have long been employed in traditional Pakistani architecture to imported products (Iqbal, Nazir et al. 2025). For example, mud or clay bricks offer natural insulation in hot climates, reducing the demand for artificial cooling, while bamboo and locally sourced wood can serve as structural and decorative elements at a fraction of the cost of international materials (Rasdi 2005). Beyond cost savings, the use of local materials also reduces the carbon footprint of transportation, strengthens sustainable construction practices (Jakhar and Jain).

In recognition of discussed challenges and opportunities, the Government of Pakistan has introduced measures such as tax exemptions,

subsidies, and certification programs to promote green construction (Soomro, Suhrab et al. 2025). While these initiatives remain in their infancy, they represent important steps toward mainstreaming sustainable practices. Nevertheless, without stronger policy support, increased industry awareness, and investment in research and demonstration projects, the impact of these efforts remains limited.

In line with the discussed barriers as discussed by previous researchers in developing countries as well as in Pakistan, the present study seeks to reaffirm the discussed barriers in the context of Pakistan. Furthermore, in contrast of previous similar studies, the present study will break down the barriers to further elements to understand the root cause and suggest mitigation measures to address barriers through a systematic approach. Therefore, the paper aims to.

1. Identify and analyze barriers to the adoption of green building practices in Pakistan
2. Explore the availability and potential of local sustainable materials and re-sources to mitigate barriers.
3. Recommending pathways to move on sustainable construction

By doing so, this research contributes to the broader agenda of promoting sustainable urban development, reducing environmental impacts, and enhancing the affordability of eco-friendly construction in developing countries like Pakistan.

2. Materials and Methods

This study employs a qualitative research design to provide an in-depth understanding of challenges and opportunities associated with green building adoption in Pakistan's construction sector. Data is gathered through unstructured, in-person interviews with key stakeholders, including contractors, engineers, architects, and material suppliers. The focus of these interviews is to elicit detailed insights into stakeholders' perceptions, difficulties, and practical experiences with green construction techniques. The research adopts a minimum interference strategy, ensuring that that data collection process does not disrupt normal business practices. This allows stakeholders' responses to reflect their natural thought

processes, organizational norms, and industry practices without artificial influence.

A purposive sampling technique is employed to select participants with relevant expertise in sustainable construction. This ensures that the sample is information-rich, comprising individuals who are most likely to provide meaningful and contextually relevant insights. By focusing on those with direct experience in green building practices, the study aims to capture nuanced perspectives that are otherwise underrepresented in conventional surveys or quantitative studies.

For data analysis, all interviews were transcribed using a verbatim method to pre-serve linguistic detail, tone, and context. Transcripts are then proofread, selectively cleaned, and validated member checking to enhance reliability. Data are analyzed thematically using MAXQDA software, involving systematic coding and the identification of recurring themes and patterns. This process allows for a structured interpretation of stakeholder's viewpoints, providing a deeper understanding of the social, technical, and institutional factors shaping the adoption of sustainable construction practices in Pakistan.

3. Results

This section presents the findings of the qualitative research conducted to examine the barriers to the creation of green buildings in Pakistan. It was observed that most of barriers were related to cost, although previous research has also discussed cost related barriers, but with the help of detailed interviews of relevant experts, a detailed cost breakdown for green buildings becomes possible to enhance understandability of the barriers. Further the potential solutions to eliminate them with the help of local materials as well as with policy recommendation is discussed. The results are categorized into the major aims of the research which are as follows, identifying the barriers, then carrying out an inquiry into the locally available green materials and finally the cost-cutting recommendations. The discussion integrates the thoughts of the participants with literature to develop an elaborate knowledge on issues and opportunities in improving sustainable construction practices in Pakistan. The section is

based on a thematic analysis to determine the implicit perceptions, practical constraints and potential policy directions that can allow the utilization of green building approaches in a cost-efficient way.

3.1. Identifying barriers

In this section the barrier to green building construction in Pakistan will be discussed along with sub categorization of resources required for green buildings. The analysis initiated with common perceptions and further supported by disintegration of discussed material and resources required for green buildings.

Barrier 1 - "The perception and reality of cost as a systemic barrier to green construction in Pakistan."

This theme underscores the multifaceted nature of cost burdens, encompassing both tangible financial constraints and perceived psychological barriers. Cost-related barriers arise from actual overhead expenses, inflated process of materials and retrofitting, uncertainty about financial returns, and widespread misconceptions regarding the affordability of green construction.

The table 1 shows the frequency and percentage coverage of the cost-related barriers to green building adoption in Pakistan. The inflated cost of green construction is the most frequently cited barrier, accounting for 24.41% of all mentions. This suggests that stakeholder perceptions pose a significant impediment to acceptance, regardless of actual costs, which may vary. Close behind are operational costs at 21.69%, indicating that ongoing expenses also deter implementation. The low return on investment (ROI), cited at 19.08%, reflects concerns that long-term financial returns may be inadequate or uncertain. The cost of material and retrofit costs are 17.97% and 16.85%, respectively, implying the financial implication of green materials sourcing and retrofit of old infrastructure. In general, the data highlights both real and perceived financial constraints as critical barriers. Addressing these concerns, particularly misconceptions about costs and ROI, can enhance the feasibility and attractiveness of green building practices among Pakistani developers and builders.

Table 1: frequency and percentage coverage of cost barriers

	Frequency
Perceived High Cost	197
Operational cost	175
Low ROI	154
Expensive Material	145
Costly Retrofits	136

Barrier 2 - “High Operational and Overhead Costs as Persistent Financial Pressure”

Overhead costs in green construction are often perceived as disproportionately high, with operational expenses frequently cited as the greatest burden. Stakeholders described the continuous spending on energy use, system upkeep, and the operation of sustainable technologies-such as solar panels and water recycling units- as prohibitively expensive. Labor and installation costs were also highlighted, largely

due to the specialized expertise required for green system deployment. Marketing and upfront expenses further compound these concerns, particularly in contexts where demand for green features remains low and public understanding is limited. Such views perpetuate the misconception that green buildings are financially draining not only during the initial investment phase but also across their lifespan, overshadowing evidence that long-term efficiencies can offset these costs.

Table 2: Frequency and percentage coverage of Overhead cost

	Frequency
Operational cost	175
Labor Cost	42
Installation Cost	36
Marketing Cost	33
Upfront Cost	27

Barrier 3 - “High Pricing of Eco-Friendly Materials and Lack of Local Alternatives”

The disintegration of expensive materials is presented in Table 3. Research Participants identified highlights wood flooring and wool insulation as among the most expensive items. These products are either imported or manufactured to meet standards, which makes them inaccessible to ordinary builders. Similarly, the high cost of timber and advanced glazing

materials, such as double-glazed or low-emissivity glass, reflects a deeper structural issue in the market, that is, the lack of affordable, locally available green alternatives. Reliance on such foreign materials reinforces the perception that green buildings is an economically exclusive venture, understanding cost as both a real and perceived barrier to sustainable construction.

Table 3: Frequency and percentage coverage of Expensive Material

	Frequency
Wood flooring	33
Wool insulation	30
Timber prices	28
Double-glazed or low-E glass costs	23

Barrier 4 - “Retrofit Complexity and High Cost in Existing Infrastructure.”

The cost dimension of retrofitting existing structures is further illustrated in Table 4. Research participants consistently identified window replacements, insulation systems, and HVAC upgrades as the primary cost driver in retrofitting projects. While these technologies are central to improving energy efficiency and reducing emissions, their integration into buildings presents significant technical and economic challenges. retrofitting often requires structural modifications, customized installations, and specialized labor, all of which substantially elevate costs.

In the context of Pakistan, where a large share of the building stock consists of aging and poorly maintained structures, these financial and technical barriers become even more pronounced. Unlike new construction projects that can incorporate sustainability features from the outset, retrofitting demands additional investment that many property owners are unwilling or unable to bear. The reluctance of the private sector to engage in green retrofitting reflects not only affordability constraints but also a lack of financial incentives, supportive policies, and accessible retrofit technologies in the local market.

Table 4: Frequency and Percentage Coverage of costly retrofits

	Frequency
Windows cost	36
Insulation cost	32
HVAC Cost	29

Barrier 5 - “Unfavorable ROI Due to Policy Instability and Infrastructure Weakness.”

The issue of low return on investment (ROI) is elaborated in Table 5, with respondents frequently highlighting the extended payback periods of solar energy systems as a major deterrent. While such systems require considerable upfront capital, the financial benefits are often perceived as delayed, uncertain, or insufficient, creating skepticism among potential adopters. This sense of finance is further exacerbated by the reduction of government subsidies and the volatility of tax incentives, which diminish investor confidence and limit the attractiveness of green technologies.

Stakeholders also pointed out additional factors that undermine the investment case for green buildings. The unreliable water supply restricts the effectiveness of water recycling or conservation technologies, while the low resale value of sustainable properties discourages real estate investors from considering them as profitable long-term assets. Together, these financial barriers reinforce the perception of green buildings as liabilities rather than assets, particularly in developing economies where cost recovery remains a critical decision factor.

This skepticism reflects a deeper systemic issue, i.e., the framing of sustainability through an economic lens that prioritizes short-term financial

gains over long-term environmental and social benefits. Without stable policy frameworks, consistent incentives, and mechanisms to capture non-financial returns such as reduced carbon emissions and enhanced resilience, the market continues to undervalue green buildings. As a

result, the cost perception barrier becomes entrenched, deterring widespread adoption and relegating sustainable construction to a niche practice rather than a mainstream standard.

Table 5: Frequency and Percentage Coverage of Low ROI

	Frequency
Solar System Long Breakeven	37
Reduced Subsidy & Unstable Tax	33
Unreliable water supply	27
Resale issues	26

Barrier 6 - "High geothermal cooling cost as the highest cost barrier."

Finally, Table 6 highlights the persistence of high-cost barriers associated with adoption of green building. Stakeholders frequently identified technologies such as geothermal cooling systems and solar inverters with metering devices as prohibitively expensive, although their affordability can vary depending on usage context, scale of deployment, and the availability of subsidies or financial incentives. Beyond technological systems, respondents also emphasized the costs associated with regulatory compliance and the shortage of skilled labor, both of which elevate the financial burden of green construction. These indirect expenses often go unacknowledged in cost estimation, yet they significantly shape the perception of green buildings as being financially inaccessible.

Even finishing elements such as bamboo flooring or double-glazed windows, which are central to

improving efficiency and sustainability, are often classified as luxury items. Such categorization reflects not only the premium attached to imported or specialized but also the absence of affordable, locally produced alternatives. The result is a widening gap between sustainable ideals and market realities.

Perceptions further amplify this barrier. Both accurate assessments of costs and exaggerated, hyperbolic beliefs about inflated expenses strongly influence market behavior. When builders and consumers perceive sustainable features as financially burdensome and lacking tangible cost benefits, adoption is hindered, regardless of the actual long-term savings or environmental advantages these features may deliver. These dynamic underscores the importance of addressing not only the structural and economic dimensions of cost but also the cultural and informational drivers of decision-making.

Table 6: Frequency and Percentage coverage of Perceived High Geothermal Cost

	Frequency
High geothermal cooling cost	38
Expensive Solar Inverters & Green Meters	36
High regulation & compliance expenses	31
Expensive Specialized Labor	30
Expensive Double-glazed windows & Bamboo flooring	27

The results and discussion of six themes reveal that cost is not a one-dimensional issue, but a complex and layered barrier shaped by financial, infrastructural, and policy-related constraints. The findings underscore a recurring duality, in a way that the barriers of cost not only in tangible financial burdens but also in the perception of affordability, both of which converge to form a systematic barrier that restricts the scalability of green building in Pakistan. This dual reality, where actual expenses intersect with entrenched beliefs about inflated costs, creates a self-reinforcing cycle that discourages adoption and innovation.

3.2. Pathways for Mitigating Barriers

This section focuses on potential mitigation strategies for addressing the cost-related and structural barriers to green buildings in Pakistan. Central to these strategies is the adoption of locally available and sustainable materials, the use of recycled resources, and the integration of energy-efficient systems. To examine these measures, data from research participants interviews were systematically coded and analyzed using MAXQDA. The thematic analysis generated five key mitigation measures to address the discussed barriers.

Mitigation Strategy 1 – “Energy-Efficient Systems Enhance Green Building Performance.”

The interviews demonstrate strong stakeholder recognition of energy efficiency as a central driver of both building performance and long-term cost control. Technologies such as solar panels, LED lighting, and passive cooling systems were consistently cited as essential to reducing operational costs while simultaneously lowering carbon footprints. Respondents stressed that while the upfront investment in these technologies remains substantial, their long-term benefits make

them indispensable for advancing sustainable construction in Pakistan.

A recurrent theme in the discussions was the importance of government incentives in making energy-efficient systems more affordable and accessible. Policies such as net metering, subsidies, and preferential tariffs were viewed as critical mechanisms for increasing adoption rates, particularly in urban centers where energy demand is high and utility bills are rising. Without consistent and transparent incentive structures, stakeholders argued, the diffusion of energy-efficient technologies risk being confined to elite projects, limiting their broader societal impact.

The data also highlighted a growing awareness of non-material design interventions that complement technological systems. Building orientation, strategic placement of windows, and natural ventilation strategies were all cited as cost-free or low-cost methods of improving efficiency and indoor comfort. These passive design measures extend the scope of energy efficiency beyond technology investment, illustrating that sustainability can be achieved through a combination of building practices.

Research participants further emphasized the life-cycle benefits of incorporating energy-efficient systems into building design. Unlike short-term measures that focus primarily on construction costs, efficiency systems provide enduring value by reducing operational expenses, improving resilience against energy price volatility, and lowering environmental impact over decades of use. In this sense, energy efficiency reframes sustainability as an ongoing process that extends well beyond the construction phase, embedding environmental stewardship into the everyday operation of the built environment.

Table 6: Frequency of Energy-Efficient Systems

	Frequency
Energy-efficient Systems	94
Environmentally Friendly	42
Reducing Pollutants	28
Day-Light Optimization	27

Mitigation Strategy 2 – “Recycled Materials Support Low-Cost and Sustainable Construction.”

The stakeholders always recognized the two-fold environmental and economic advantage of using recycled construction materials. Recycled plastics, steel, and recycled wood are emerging as promising alternatives to virgin materials, particularly in urban housing and infrastructure projects where cost pressures are significant. Respondents emphasized that these materials not only reduce landfill waste and conserve natural resources but also provide comparable structural strength, making them suitable in a wide range of applications.

At the same time, concerns were raised regarding inconsistent quality standards and the lack of regulatory frameworks to ensure the safe reuse of recycled components. Without established certification systems or robust oversight, stakeholders worried that adoption could be hindered by safety risks and public mistrust. To overcome these challenges, participants advocated for stronger public-private partnerships aimed at

building infrastructure for collection, sorting, and certification of recycled materials. Such systems would help standardize quality, enhance trust among users and consumers, and create a stable supply chain for recycled resources.

The findings also highlight the importance of workforce development, training local workers, contractors, and small-scale builders in the use and integration of recycled components was frequently mentioned as a necessary step to mainstream this practice. Beyond construction, some participants linked recycling to broader circular economy models that could be extended to manufacturing, demolition, and material recovery industries, thereby embedding sustainability across the value chain.

In general, recycled materials are one of the strategic possibilities to develop green buildings in an affordable way and to meet global sustainability objectives like waste reduction and responsible consumption.

Table 7: Percentage coverage of Recycled Material

	Frequency
Recycled plastic	33
Recycled steel	26
Reclaimed wood	23
Recycled glass	20

Mitigation Strategy 4 – “Sustainable Resources Help Conserve Water and Energy”

The sustainability of resource systems was considered essential for reducing a building’s reliance on overloaded municipal supply networks. Stakeholders highlighted that water systems such as rainwater harvesting and greywater reuse are particularly important in drought-prone regions of Pakistan, where freshwater availability is scarce. Respondents noted that low-flow fixtures and water-efficient landscaping can significantly reduce consumption without compromising user comfort.

Other energy solutions identified included solar power and biogas systems, which are especially

useful for off-grid applications in remote or underserved communities. However, interviews revealed that high initial costs and a lack of technical expertise hinder their wider adoption. To address this, respondents suggested pilot programs, community demonstrations and tax incentives as potential ways to encourage broader implementation.

They further emphasized importance of integrating such systems into building codes and green certification practices. Sustainable sourcing, therefore, emerges not only as a necessity but also as an opportunity to reduce operational costs,

alleviate environmental pressures, and enhance the resilience of buildings in Pakistan.

Table 8: Percentage coverage of conserving natural resources

	Frequency
Water	28
Energy	20

Mitigation Strategy 5 - "Traditional Materials Offer Simple and Sustainable Solutions"

The materials of traditional construction such as mud, lime, straw, and thatch are re-emerging as a sustainable solution because of their low embodied energy, local supply, and climate flexibility. Their thermal performance was lauded by stakeholders and in hot areas, these materials are capable of naturally cooling the indoors and minimizing the use of mechanical cooling systems. Beyond these conventional choices, bamboo, stone, and cool roof technologies were recognized as cost-effective substitutes for imported and resource-intensive materials. Similarly, reclaimed wood, cork, straw bales, and sheep wool were cited as affordable and environmentally responsible resources that combine thermal efficiency with economic viability. Most of these materials are either locally sourced or recyclable, which enhances accessibility for small-scale builders and reduces the energy intensity of production, thus aligning with low-carbon construction goals.

The interviews also highlighted the importance of accessibility alongside affordability. In remote or under-resourced areas, locally available materials such as clay, earth, and terrazzo were praised not only for their cost-effectiveness but also for their role in minimizing transportation emissions and logistical expenses. Respondents suggested that improved distribution networks and the

establishment of local production centers would significantly facilitate the wider adoption of green materials, ensuring that sustainable choices are practical at scale. Innovative options such as fly ash concrete, hempcrete, cool bricks, and stabilized mud blocks were noted as effective hybrids that integrate traditional wisdom with modern engineering, providing a bridge between cultural heritage and contemporary performance standards.

Despite their advantages, concerns remain regarding safety standards, certifications, and public perceptions. Some respondents expressed that traditional materials are often viewed as outdated or inferior compared to modern, imported alternatives. This perception not only diminishes their acceptance but also undermines their potential contribution to sustainable development. To overcome this barrier, stakeholders recommended awareness campaigns, technical demonstrations, and the showcasing of successful green projects that incorporate traditional and hybrid materials. Such initiatives can help reposition these resources as modern, culture-appropriate, and environmentally sound solutions rather than symbols of backwardness.

Table 9: Frequency of available local materials

Local Materials	Frequency
Mud	30
Lime (for lime plaster and mortar)	26
Straw and Thatch	25

Fiber cement	25
Sand	23
Natural stone	23
Cool Bricks	22
Bamboo	14
Stone	9
Cool roofs	7
Reclaimed Wood	7
Cork	7
Straw Bales	6
Sheep Wool	5
Clay and Earth	7
Terrazzo	6
Rammed earth	12
Hempcrete	10
Fly ash concrete	17

Mitigation Strategy 6 – “Cost Reduction through Integrated Design and Resource Strategy.”

The analysis highlights the most frequently identified pathway to reducing the cost of green buildings is the adoption of efficient design strategies, followed by using affordable and locally sourced materials, renewable energy technologies, and accessible supply chains. Research participants particularly emphasized the role of solar panels, photovoltaic glass, and passive solar design as key strategies for lowering long-term building costs. These approaches were seen as evidence of growing awareness that energy-conscious design not only reduces utility bills but also enhances overall building performance and resilience.

The interviews revealed a strong consensus that cost reduction must begin at the conceptual and design stage, where energy-efficiency, passive cooling, and space optimization can be embedded into the architectural framework. Professionals noted that green construction should not be

perceived as a luxury choice requiring high-cost materials or advanced technologies. Instead, it represents a design philosophy that emphasizes careful planning, efficient use of resources, and the elimination of redundant systems. In this sense, local expertise and context-sensitive innovation were regarded as equally important as technological advancements.

The availability of affordable local materials further reinforces this approach by reducing dependence on expensive imports. While renewable technologies such as solar and biogas systems demand significant upfront investment, stakeholders recognized their long-term potential for reducing operational costs and increasing energy independence. When combined with efficient design, these technologies can shift green buildings from high-cost projects to practical and economically feasible solutions.

Table 10: percentage coverage of minimizing cost by integrated design and resource strategy

Mitigation measures	Frequency
Efficient Designs	100
Affordable Material	74
Renewable Energy Solutions	55
Accessible Material	41
Solar Panels and Photovoltaic Glass	24
Passive Solar Design	20
Energy-Efficient Windows and Doors	14
High-Performance Insulation	10

Mitigation Strategy 7 – “Renewable Technologies as Long-Term Cost Saving Mechanisms.”

The findings highlight renewable energy technologies as both environmental solutions and strategic tools for achieving long-term financial sustainability in the construction sector. Stakeholders most frequently identified solar energy and sustainable architectural practices as the leading renewable approaches for reducing operational costs in green buildings. Other technologies discussed included off-grid or hybrid systems supported by performance monitoring instruments, as well as biomass energy and small-scale wind turbines. Together, these solutions were viewed as promising avenues for reducing dependence on centralized energy supply while lowering life-cycle costs.

Respondents acknowledge that the initial investment in renewable systems such as solar photovoltaics or biomass facilities can be substantial, often discouraging uptake in resource-constrained contexts. However, they emphasized that these costs are offset over time through significant savings on utility bills and the re-

liability of self-generated power. In areas prone to energy shortages or grid instability, renewables were regarded as particularly advantageous, offering both financial predictability and greater resilience.

Performance monitoring systems were also highlighted as a complementary innovation, enabling building managers to track energy use,

identify inefficiencies, and maximize the returns from renewable technologies. According to research participants, the adoption of these technologies depends heavily on supportive financial and regulatory frameworks. Stable subsidies, accessible financing schemes, and streamlined approval processes were viewed as necessary enablers for integrating renewable energy systems into mainstream construction. Without such measures, renewable adoption risks being limited to high-end projects rather than contributing to widespread transformation across the sector.

Table 11: percentage coverage of using renewable energy resources as effective cost tools

	Frequency
Solar power	14
Sustainable Architecture	14
Performance Monitoring System	13

Biomass energy	9
Wind turbines	8

Mitigation Strategy 8 -- "Motivating Factors for Green Building Adoption."

The analysis reveals a diverse set of motivating factors driving the adoption of green buildings in Pakistan. Stakeholders most frequently emphasized the availability of affordable and accessible green materials, the application of sustainable architectural practices, and the role of integrating design features such as insulation, ventilation, and natural lightning. These elements were not only viewed as central to improving building performance but also as enhancing occupant comfort without imposing prohibitive costs. Insulation was consistently identified as a practical means of reducing energy consumption in both hot and cold weather conditions, while adequate ventilation and natural daylight were associated with improved indoor air quality, health, and overall productivity.

A strong narrative also emerged around the human-centric value of green buildings. Respondents highlighted benefits such as occupant comfort, well-being, productivity, and health underscoring that sustainable construction is increasingly understood as a strategy to enhance the quality of life rather than being solely about environmental protection. In commercial contexts, productivity gains linked to better indoor environments were especially influential in motivating adoption. This marks a perceptual

shift, where green buildings are no longer regarded as a moral or regulatory obligation but as investments in human experience and workplace efficiency.

The durability, resilience, and operational efficiency of sustainable architecture were also cited as major incentives. Stakeholders appreciated the ability of green buildings to withstand climate stresses, reduce long-term maintenance costs, and provide structurally sound environments that remain comfortable without heavy reliance on mechanical systems. Such attributes were recognized as essential for ensuring cost-effectiveness and for extending the lifespan of buildings in a re-source-constrained setting.

An important insight from the interviews is that adoption becomes more appealing when green materials and sustainable design methodologies are combined in a way that balances performance with livability. Marketing green buildings as enhancers of quality of life, through comfort, health, and resilience, was seen as a promising approach to shift perceptions and encourage wider adoption among both end-users and private sector developers.

Table 12: Motivational factors for green buildings adoption

	Frequency
Green Material	127
Sustainable Architecture	97
Green Design	76
Insulation	21
Ventilation	16
Natural Lightning	15
Improved Quality of Life	65
Occupant Comfort	18

Well-being	10
Productivity	8
Health	7
Resilient Structure	21
Indoor quality	19
Cost effective	17
Comfortable spaces	15

The results highlight that the primary barriers to green building adoption in Pakistan are largely cost-related. However, the study also suggests several mitigation strategies, including the use of locally available materials, adoption of integrated design approaches, and motivating clients by emphasizing the key benefits of green buildings.

4. DISCUSSION

The findings of this study contribute new empirical evidence on the adoption of green building practices in Pakistan by moving beyond the generalized claim that 'cost' is the only barrier. Instead, the study disaggregates cost into specific dimensions such as, high operational expenses, reliance on costly imported materials, limited uptake of passive design strategies, and misconceptions about affordability, to suggest targeted mitigation measures. By grounding these insights into stakeholder perspectives, the study offers a more localized and actionable understanding of barriers and pathways toward sustainable construction.

4.1. Cost as a Major Barrier

Following the previous research, the present study affirms that the cost, both actual and perceived, is the overwhelming barrier to the green building adoption in Pakistan. Research participants frequently cited high operations cost, expensive materials, costly retrofitting, low return on investment, and misconstrued perceptions about the cost of green building. As per Siganul (2025), they observed that the factor most frequently mentioned by respondents as a barrier to the implementation of green buildings in developing economies is high initial capital costs. Research

Participants also emphasized high operational costs, low returns, and costly materials as critical issues (Siganul and Puspitasari 2025). However, as compared to the past studies, this study has found that uncertainty and misinformation regarding cost benefit tradeoffs are deeply rooted within the decision culture of the Pakistani practitioners. Although Sarifudin (2024) and Karamoozian (2025) have addressed perceptions of cost more generally, the results of this study link such perceptions to the absence of localized evidence on cost-benefit ratios and the financial structure of the government, providing a more context-specific picture (Sarifudin and Jin 2024, Karamoozian and Zhang 2025). The widespread association of sustainability with complexity and cost among professionals further reflects a breakdown in policy communication as well as an educational gap in architecture.

4.2. Potential of Local and Sustainable Materials

The second important lesson is associated with the utilization of local and sustainable materials as viable alternatives to costly imported green products. Mud, lime, straw and natural stone were considered universally available, cheap, and climate-friendly materials. Research by Okwandu (2024), indicates the thermal performance and cultural appropriateness of the native materials in the South Asia environment (Okwandu, Esho et al. 2024). A key contribution of this study is its focus on local material usage mud, straw, lime, and stone as a viable pathway to reduce costs and increase sustainability. Previous literature emphasizes the performance and eco-friendliness of alternative materials, but little empirical research explores their acceptability

(Ahmadizadeh, Heidari et al. 2024) or strategic role in Pakistan's context. This study fills that gap by showing that these materials are not only culturally resonant but also economically feasible and technically underutilized. Moreover, stakeholders associated local materials with lower transportation emissions, support for local economies, and resilience in Pakistan's climate a set of outcomes not deeply addressed in past green construction discourse. This study, therefore, extends the literature by highlighting the underexplored intersection of cost, culture, and sustainability in local material use.

In addition, the study presents a new insight into the trust gap that surrounds indigenous materials, particularly in urban construction. Even though local resources have proven performance, they are often dismissed by professionals as "non-modern" or lacking in structural legitimacy. This presents an opportunity for policymakers and educators to reposition traditional knowledge as a valid and scientifically supported input into green building systems. Bridging this divide could also stimulate localized green entrepreneurship, encouraging innovation in hybrid material technologies that combine traditional resources with modern techniques.

Energy efficient systems were also found to be crucial in improving the performance of green buildings and cutting lifecycle costs. The stakeholders focused on such technologies as solar panels, photovoltaic glass, passive solar design, and energy-efficient windows. These systems assist in optimal energy consumption and lessen the reliance on fossil fuels, conclusions that are like those of Abdel Hay bin Omera (2024), who stated that efficient building envelopes and renewable integration result in substantial operations savings over time.

4.3. Strategies to Minimize Cost

Followed by local material usage, the stakeholders proposed the use of integrated design solutions, to use local materials that are cheap and accessible and incorporation of renewable energy systems as feasible solutions. The role of effective design was well highlighted especially about passive measures and optimization of natural resources. The insights can be compared to a study by Sanboskani

(2022), who discovered that the design decisions made in the initial stages have significant impacts on both capital and the operational costs (Sanboskani, El Asmar et al. 2022). Our findings demonstrate how these strategies are often sidelined due to lack of awareness, professional training, and fragmented policy support.

The choice of low-cost materials like bamboo, cool roofs, and straw bales are contributed by this study and results indicated that green premiums can be cut radically with the use of locally available substitutes. By anchoring this insight in qualitative evidence from Pakistani stakeholders, the study adds localized depth to the international narrative on cost optimization. Moreover, while Abid (2025) provides a general economic outlook for renewables (Abid, Al-Wathinani et al. 2025), our research underscores that stakeholder acceptance hinges on context-specific adaptations and trust in long-term performance, which are missing from most green discourse in Pakistan.

In addition, this research sheds light on the disconnect between design potential and implementation reality. Many passive design concepts—like solar orientation, shading, insulation, and water harvesting—are well understood in theory but rarely applied. This is not due to feasibility constraints, but rather a disconnect between design curriculum, construction practices, and client expectations. Thus, the study contributes to literature by showing that green building strategies in Pakistan require ecosystem-level change, including education, client engagement, and policy alignment.

4.4. Factors Influencing Adoption

Lastly, the paper has examined the issues that affect adoption of green building in Pakistan. The most important drivers were the application of green materials, sustainable building, energy-efficient building, and enhancement of the quality of life. While studies by Hussain (2025) and Bashir et al. (2024) affirm the health and productivity benefits of green buildings, our findings offer a novel angle: these benefits are not effectively communicated or emphasized during design and project planning phases in Pakistan (Bashir, Khan et al. 2024, Hussain, Naqvi et al. 2025). This

results in a missed opportunity to frame sustainability as a practical and human-centered investment rather than a technical or financial burden.

The contribution of sustainable architecture to resilience and cost-effectiveness was also highlighted. Factors like durable structures, effective indoor air systems, and flexible design were critical to the building performance. The green design elements, which included ventilation, insulation, and natural lighting, were also seen by participants as significant contributors to energy efficiency and well-being of the occupants. Additionally, the study sheds light on the systemic absence of enabling institutions and professional training, which further limits adoption. Although Ahmad (2024) and Batool (2024) highlight the architectural benefits of resilience, ventilation, and insulation (Ahmad, Gunduz et al. 2024, Batool, Ali et al. 2024), our research suggests that these elements are often excluded from standard practice due to lack of demonstration models and limited incorporation into building codes. Therefore, this research contributes by demonstrating how adoption is not only a policy issue but also a knowledge translation challenge.

Another important contribution of this study lies in its exposure of the disconnect between academic knowledge and professional practice in the Pakistani construction sector. Even though most of the green building concepts including passive design, local materials and life-cycle costing are taught in architecture schools, these concepts are hardly applied in the real world because of the absence of institutional support. According to stakeholders, green concepts are being considered as elective or theoretical courses as opposed to industry-ready standards and therefore the graduates lack the necessary preparation to apply the concept of sustainability in their professional work. This discrepancy implies that changes in architecture and engineering education are required, especially in the form of the introduction of practical green design courses, certification courses, and cooperation with the industry.

Also, the study finds that there is a shortage of pilot projects and living labs, which could be used

as evidence of concept to the industry in general. Performance-supported demonstration projects featuring low-cost, locally sourced green buildings may help to dispel popular misconceptions regarding affordability and feasibility. Such initiatives could be funded by the partnerships between state and private organizations, grants by the city, or innovation hubs by the universities, as in the case of India and Southeast Asia (Marksel, Pavletič et al. 2024). The country can speed up the diffusion of knowledge and policy advocacy by developing visible and working models of sustainable buildings in the urban and peri-urban setting of Pakistan.

Collectively, these results not only confirm what is already known about the impediments to green building in the developing economies, but they also provide new leads based on cultural context, professional capacity, and grassroots innovation, and

5. Future research

While this study provides valuable insights into the cost-related challenges and opportunities associated with green building practices in Pakistan, it also opens several avenues for future research. One important direction is to conduct quantitative studies that evaluate the actual cost savings achieved through local materials and energy-efficient systems over time. This would help validate or challenge the perceptions identified in this research and offer hard data to guide developers and policymakers.

Additionally, comparative studies between different regions of Pakistan could explore how geographical, economic, and climatic conditions influence the viability and perception of green construction. It would also be useful to investigate the role of financial institutions and real estate developers in shaping the adoption of sustainable practices, particularly through lending practices, insurance premiums, and valuation models.

Another promising area is to study user behavior and satisfaction in existing green buildings. Measuring occupant comfort, health, and productivity outcomes can help build a stronger case for the social benefits of sustainable architecture. Furthermore, future research should examine the effectiveness of government policies

and incentive schemes in driving change, as well as the institutional barriers that delay their implementation.

Finally, studies that engage contractors, suppliers, and craftsmen in rural and peri-urban areas could provide a deeper understanding of the ground-level challenges and opportunities. This type of grassroots research is crucial to designing interventions that are inclusive, scalable, and grounded in the local context.

6. Limitations of the research

This study is qualitative in nature and based primarily on interviews with a limited number of stakeholders, which may not fully represent the diversity of perspectives across Pakistan's construction sector. The findings are therefore more exploratory than generalizable. While the use of MAXQDA provided systematic coding and thematic clarity, the interpretation of themes still relies on subjective judgment.

7. Recommendations

- It is recommended that an autonomous and empowered national authority be established to not only monitor but also implement green building policies across Pakistan.
- The government should embed green building standards within national and municipal construction bylaws, making sustainable practices a regulatory requirement.
- Registered green building material suppliers should be actively promoted by the government through incentive schemes, tax rebates, and public recognition. Registration and monitoring should be simplified and made simple for all stakeholders.
- In government-funded infrastructure and public housing projects, preference should be given to pre-qualified and registered green suppliers. This recommendation is driven by the results of this research that the aspect of material accessibility and supplier trust is lacking under the existing system. The government can encourage green entrepreneurship by giving priority to registered green suppliers during the public tenders and thus establish a market of sustainable production and distribution of materials.

7.1. Recommendations for Suppliers

- This research recommends that suppliers are encouraged to formally register as certified green building material providers with relevant national bodies such as the Pakistan Green Building Council (PGBC) or Pakistan Engineering Council (PEC). This registration not only enhances credibility but also enables access to government incentives, public procurement opportunities, and recognition within the sustainable construction eco-system.
- Findings of this research recommend that suppliers should actively work to make green building materials widely accessible and affordable by leveraging digital platforms, retail partnerships, and targeted outreach through social networks. In addition, they should explore opportunities in international markets for sourcing sustainable materials and engage with the government to advocate for import subsidies, reduced duties, and supply chain facilitation for eco-friendly products.
- To encourage broader adoption, suppliers should implement strategies to reduce the overall cost of green building materials, including lowering upfront, production, and retrofit expenses.
- This research recommends that suppliers should adopt competitive pricing models with modest profit margins to attract clients, promote volume sales, and demonstrate the long-term value of sustainable material alternatives.

7.2. Recommendation for Clients

- It is recommended that clients with sufficient financial capacity should take the lead in adopting green building practices, recognizing their long-term environmental, economic, and social benefits.
- This research also recommends that consumers should be made aware of the long-term advantages of green materials, including energy savings, improved indoor comfort, and enhanced property value to help shape a more positive perception.
- The research recommends that consumers are encouraged to follow certified green building designs and structural models not only to comply with current or upcoming

regulatory standards but also to ensure efficient performance and sustainability of their homes or buildings. This is crucial to the maximization of the passive design strategies and consistency with the green compliance frameworks of the future.

- It is also the duty of consumers to stay informed about available government subsidies, incentives, and rebates for green construction. As this research has found out, not all clients are aware of such possibilities, which means that such financial assistance is poorly used, and the initial cost of construction can be reduced substantially.
- Lastly, this research recommended that clients should actively seek guidance from trained architects, designers, and registered suppliers to explore all viable methods and materials for green building implementation.

CONCLUSION

This study set out to explore and address the persistent cost-related barriers to green building construction in Pakistan. Despite growing global awareness about sustainable practices, the uptake of green buildings in developing countries like Pakistan remains limited. The research was structured around four core objectives: identifying cost-related barriers, exploring available materials and methods, recommending cost-reduction strategies, and examining factors influencing the adoption of green building practices. Through a qualitative approach using stakeholder interviews and thematic coding in MAXQDA, the study uncovered rich, practical insights grounded in local realities.

The findings reaffirm what many in the field have long suspected: the primary hurdle to green building is not merely financial but deeply rooted in perception.

There is a preconceived notion that construction of a green building project is costly, and too technical; contractors, designers, and developers assume that they can only build a green structure when they are dealing with big developers. Such impressions as they are exaggerated by the lack of awareness of cheaper options and the lack of support infrastructures. They also discovered that real financial obstacles, including inflated cost of materials, expensive retrofits and low returns on

investment are yet another disincentive to adoption.

Over the same period, the study has revealed potential routes towards the price and complexity of green buildings. Local resources such as mud, lime, straw and rocks became both cheap and climate and culturally suitable. Similarly, incorporation of recycled products and sustainable materials (e.g., fly ash concrete, reclaimed wood, and bamboo) may also reduce cost and serve environmental aims. The use of energy-saving systems as well as passive design schemes have been mentioned numerous times, as viable means of enhancing building performance in terms of operations and at the same time minimizing costs. These findings highlight the idea that with adequate knowledge and policy provisions, green buildings are cheap and functioning.

The importance of education and awareness on market behavior is among the most important things I learnt out of this research. Most of their stakeholders, including old builders and architects, continue to utilize old or partial information on cost implications of sustainable design to run their businesses. This points to the need to have training programs with demonstration programs and public awareness programs launched by the government to overcome the myths and to create self-confidence on permanent solutions.

The study also gave some guidelines of effective recommendations in that it was pointed out that there were certain guidelines on how to standardize and certify the local materials in building confidence and increase their access by the regional distributed hubs and also work on providing financial incentives to promote the use of green technologies. It is also worth making a new definition of green buildings to give them another meaning rather than being an environmental requirement but a measure to improve the health of their occupants, their comfort, and their productivity.

In conclusion, the paper provides an empirical understanding of how the construction of a more sustainable industry can be introduced in Pakistan. The tools, materials and methods are already where the locals are, and barriers exist

particularly on the perceptual and policy support fronts. To realize the full potential of green buildings in the country, aligning of market incentives, regulatory frameworks and professional attitudes now lies in the bag.

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Abbreviations

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