# SOCIAL SCIENCE REVIEW ARCHIVES

## Economic Determinants Influencing the Adoption of Environmental Sustainability in Construction Projects: Empirical Evidence from Punjab, Pakistan

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## Abstract

Construction industry is an important factor in the economic growth and infrastructural development of the developing economies, but its high pace has negatively impacted the environment because of the poor adaption of sustainable construction standards. Although the growing focus on environmental sustainability is being witnessed across the globe, its introduction in construction projects in the developing-country setting is limited by economic factors. This paper analyses the economic factors that determine the implementation of environmental sustainability in building projects in Punjab, Pakistan, based on triple bottom line approach. The quantitative cross-sectional research design was used and 100 construction project engineers were used as primary data by a structured questionnaire. Descriptive statistics, Pearson correlation, and multiple regression analysis in SPSS were used to analyze the data. The empirical findings show that high initial cost of sustainable materials negatively impact the adoption of sustainability ($\beta = -0.41$, $p < 0.01$), which means that the sector is very sensitive to costs. Lack of financial incentives and government subsidies also exhibit a strong negative correlation with sustainability adoption ($\beta = -0.29$, $p < 0.05$), which supports the tendency of firms to use traditional methods of construction. Less confidence in the return on investment also has a negative impact on adoption decisions ($\beta = -0.33$, $p = 0.01$) especially on those projects with short financial goals. Stakeholder demand, by contrast, has a positive, though less significant impact on sustainability adoption ($\beta = 0.18$, $p < 0.05$), which indicates low levels of market awareness and client pressure to go green with construction. The regression model can account about 62 percent of the change in sustainability ($R^2 = 0.62$), which highlights the preeminent role of economic factors on any sustainability-related decision. Its results offer solid empirical evidence based on the situation in developing countries, and emphasize how specific financial contributions, subsidy systems, and policy measures are necessary to make rapid progress towards the use of environmentally friendly construction methods.

**Keywords:** Sustainable Construction, Economic Challenges, Environmental Sustainability, Construction Projects, Punjab, Pakistan

## Introduction

The construction industry is largely known to be a pillar in economic growth with a significant role of providing a substantial contribution in creation of employment, growth of urban areas, and provision of infrastructure in both the developed and the developing economy. Concurrently, it is among the most resource-demanding and environmentally regulating sectors, which contribute to a high portion of world energy usage,

raw material mining, waste production, and greenhouse effect. As a reaction to these issues, environmental sustainability has recently become the main theme of construction research, policy debate, and practice. Ecologically friendly practices in construction include energy efficient designs, environmental-friendly materials, waste reduction, and lifecycle-based decision-making, are being advocated as necessary to minimize the environmental impact of the built environment in addition to facilitating economic and social development in the long term. Although there is a wide agreement on the significance of sustainability, the practical implementation of this concept in construction projects has been skewed, especially in the developing countries. As much as developed economies have achieved good strides by implementing regulatory measures, tangible influences and commercial demand of green buildings, most developing economies still have low adoption levels. This difference cannot purely be explained by differences in technology or regulations, but it is more a reflection on the underlying structural and economic limitations that influence the decision-making both on the project and Organisational level. Under such circumstances, the construction companies tend to work under narrow financial margins, scarce access to capital, unstable market situations, and significant rivalry in costs, which affect their readiness and capability to invest in sustainable options. Pakistan is a good case study of this dilemma. This has led to a booming growth in the construction sector over the last few years due to increased population growth, urbanization, state infrastructure project, and the real estate development of the population by the private sector especially in the province of Punjab. Although this growth has been positive in terms of economic performance, it has also increased pressure on the environment due to higher resource consumption, emissions, and waste. The policy documents at both the national and provincial level are now focusing on sustainability, green financing and green infrastructure resilient to climate change, but little has been done to improve the transfer of these policy ambitions to daily construction practice. Practical experience indicates that the construction works in Pakistan mainly utilize traditional construction materials and constructions where sustainability concepts remain secondary or optional issues than a fundamental part of the project planning and execution. An increasingly rich international literature is finding economic considerations as one of the key obstacles to the implementation of sustainability in building. Expensive initial investments in sustainable materials and technologies, lack of confidence in the long-term financial payoff, scarcity of financial incentives or subsidies, and a low capacity to attract clients in the market have always been listed as key factors of hurdle. When lifecycle analyses tell decision-makers that sustainable solutions can bring long-term cost reductions such as through decreased energy use and lower capital maintenance costs, all too often decision-makers give short-term affordability and minimum capital cost a top priority. Such a trend is especially high in emerging markets where financing sources are limited and the risk-aversion is not high. As such, sustainability investments are frequently viewed as being risky in terms of finances as opposed to being economically strategic. In Pakistani context, the body of research that has been done has mostly been on environmental awareness, technical feasibility, or regulatory obstacles relating to sustainable construction. Although these studies are very insightful, they do not give sufficient empirical analysis of the particular economic factors that influence adoption decisions at the project level. Further, most of the evidence at hand is qualitative or conceptual and very few studies have been conducted that use a quantitative approach to measure the strength and importance of economic factors in determining the adoption of sustainability. This gap restricts the capacity of policy makers and industry players to develop specific interventions that tackle the most significant limitations to the practitioners. These dynamics revolve around the role of construction professionals, in particular, project engineers. The project engineers are at strategic position between strategic decision and implementation at the site. They are closely engaged in the process of material selection, costs estimations, procurement processes and daily management of the project and hence they have first-hand experience of the trade-offs involved in sustainability integration in practice. Their perceptions and experiences offer some insightful information on the manner in which economic factors are conceived and actualized within actual project situations. Nevertheless, a systematic study of the views of project engineers in Pakistan is not covered by empirical

studies.

**Literature Review:**

Theoretically, sustainable construction practices can be interpreted in a contextual way, which is an integrated economic and behavioral perspective. The triple bottom line approach states that it is necessary to reconcile the economic performance with the environmental safeguard, and social well-being, but in reality, economic factors tend to prevail in decision-making. The stakeholder theory also indicates that clients, regulators and financiers' pressure have an impact on adoption whereas the diffusion of-innovation theory indicates that the perceived relative advantage, cost and risk influence adoption behavior. Innovations aimed at sustainability are less likely to be adopted outside a niche in situations that have a low level of stakeholder pressure and in which financial incentives are scarce. All these theoretical lenses emphasize the need to discuss economic drivers and constraints as the critical explanatory variables, as opposed to the secondary ones.

It is on this background that the current study will examine the economic factors that affect the practice of environmental sustainability in construction projects within the state of Punjab in Pakistan. With a central theme of analyzing the core economic variables, i.e. the cost of sustainable materials, the availability of financial incentives and subsidies, uncertainties on the returns on investment, and the demand of the stakeholders, the study aims to measure their impact on sustainability adoption through a stringent quantitative methodology. Through the utilization of survey data of the construction project engineers and the application of multivariate statistical analysis, the study passes the descriptive accounts to provide the empirical evidence of the relative significance of various economic factors.

The study has various contributions to the literature. First, it offers context-specific empirical data in a developing-country context in which the adoption of sustainability has not yet permeated the population despite the growing policy focus. Second, it separates and measures the effects of individual economic variables and allows clearer prioritization of policy and managerial intervention. Third, it enhances the methodological foundation of sustainability research in building through justifying quantitative data of economic perceptions among professionals. Lastly, the findings provide practical implications to policymakers, industry managers and project managers who wish to develop financial, regulatory and market-based mechanisms that can help in aligning the economic incentives with the goals of environmental sustainability.

This study addresses a gap in both scholarly literature and practical policy coverage that is critical based on the need to address the economic underpinnings of the process of sustainability adoption in construction projects. The need to comprehend the influence of economic constraints on practitioner behavior is the key to continued development of sustainable construction beyond the realms of aspirational rhetoric and entrenching it as a more attainable and mainstream practice in the construction industry of Pakistan and other similar developing economies.

Sustainable construction has continued to be highly advocated as a key mechanism to minimize the environmental footprint of the built environment and ensure high economic and social development over a long period of time. Nevertheless, even though significant progress has been attained in the fields of green technologies and design standards, the adoption rates are not even across the regions and types of projects. One of the leading explanations that come out of the literature is the fact that economic decision-making under uncertainty is the core determinant of sustainability adoption in construction and not technical feasibility as such (Hill and Bowen, 1997; Hwang and Tan, 2012). The construction companies usually work in the very competitive markets with the thin profit margins, supply chains that are disintegrated and the high pressure of costs that increase the sensitivity to capital expenditures and financial risks.

The financial and economic barriers are always found to be the most serious hindrances to sustainable construction, outweighing technical, regulatory, or knowledge-based restrictions (Darko and Chan, 2017; Djokoto et al., 2014; Zhang et al., 2022). These works come to the same conclusion that although the understanding of the benefits of sustainability has grown, companies are still unwilling to implement those

practices that may increase the initial costs of the project or create uncertainties in terms of financial planning. This trend is especially strong in the developing economies, where the long-term financing is minimal and the systems of risk-sharing are inefficient.

The most widely used barrier mentioned in the literature is the high initial cost of green technologies and sustainable materials. Empirical research in Asia, Africa, and Middle East indicates that construction practitioners consider sustainable materials, i.e., the use of energy-efficient systems, low-carbon cement, recycled aggregates, and green insulation, to be much more costly than conventional ones (Ametepey et al., 2015; Ashish et al., 2019; Bashir et al., 2024). Procurement decisions are in many instances swayed by initial capital cost even where long-term cost-benefits are established by lifecycle cost estimates in terms of lower energy consumption and lower maintenance.

This short cost orientation is based on current budgeting trends in the construction sector, in which projects are not considered based on their complete value but on their capital cost (Marcelino-Sadaba et al., 2015). Consequently, sustainability investments have a common image of a burden of costs, instead of value-added approaches. Regression analysis in quantitative studies always demonstrates a statistically significant negative correlation of perceived cost with sustainability adoption, which means that perceived costs significantly decrease the probability of implementation (Darko et al., 2018; Osei-Kyei and Chan, 2017).

In order to offset such high initial expenditures, financial incentives and subsidies to encourage sustainable construction are becoming more and more popular by governments and financial institutions. These are tax rebates, concessional loans, grants and green financing instruments. Empirical data indicate that these incentives may increase the adoption rates greatly, once they are available, foreseeable, and consistent with the industry trends (Hwang et al., 2017; Zhang et al., 2020). The success rate of incentives is however different in different contexts.

Incentive schemes usually have low coverage, become cumbersome and have low institutional capacity to make an impact in a developing country (Aghimien et al., 2020). South Asia studies have found that construction professionals often find subsidies unavailable or too hard to get, and such a factor reduces their impact on decision-making (Khahro et al., 2021). Pakistan There are current policy efforts in the country, such as green financing structures and provincial sustainability plans, which indicate the growing institutional backing; however, the empirical analysis shows that these instruments have not been yet converted into extensive project-level implementation (Ali et al., 2023). In turn, the perceived accessibility to incentives is an important factor of sustainability adoption.

In addition to the issue of costs, the uncertainty over the investments in terms of return on investment (ROI) is a key factoring factor in the process of introducing sustainability. Construction projects are characterized by long periods to maturity, complicated stakeholder structures, and vulnerability to market risk, and all these compound the perceived financial risk. The returns of sustainable construction investments are not always short term and measurable, but they always induce benefits over a longer period of time through energy savings, higher asset value, or lower environmental liability (Zuo and Zhao, 2014).

Empirical research always shows that greater perceived ROI uncertainty is related to reduced adoption of sustainable practices (Hwang and Tan, 2012; Darko et al., 2018). This is especially intense in situations, where reliable performance information, presentation projects, and standardized evaluation systems are not available. In Pakistan, the lack of empirical data on the financial success of green buildings is only contributing to the lack of certainty, which further increases risk-averse behavior among project stakeholders (Hussain et al., 2023).

Although economic constraints are a downward influence on adoption, the force of stakeholder demand may also serve as a counterbalance. The theory of stakeholder hypothesizes that organizations act in a strategic manner in response to stresses by clients, regulators, investors and end-users (Freeman, 1984). Empirical research indicates that high client demand, specifically institutional buyers and clients in the public sector necessitates a high probability of sustainability integration into construction projects (Osei-Kyei et al., 2020;

Zhang et al., 2022).

Nonetheless, the idea about sustainability benefits does not yet have much awareness among clients in most developing economies, such as in Pakistan, where the buying process is controlled by cost factors (Hussain et al., 2023). Consequently, demand pressure by the stakeholders frequently has a relatively small impact on adoption, which is not enough to compensate financial barriers. This poor market pull highlights the need to implement concerted efforts to promote policy interventions based on incentives and awareness-creating, as well as, strict implementation of regulations.

Despite the vast body of international evidence regarding the barriers to sustainable construction in the form of economics, there are few studies, which focus on Pakistan. The existing literature has been more oriented to the conceptual debate, technical feasibility, or environmental consciousness, and minimal focus on the empirical testing of economic determinants with the use of multivariate tools (Khahro et al., 2021; Ali et al., 2023). Besides, there is a lack of studies that systematize the views of project engineers, even though they are significant in the decisions of procurement and implementation. This disparity limiting the formulation of evidence-based policies that may be responsive to the economic realities of the Pakistani construction industry and especially in Punjab where the construction industry is concentrated the most.

Based on the literature reviewed and theoretical views, the hypotheses are formulated as follows:

**H1:** The perceived high prices of sustainable materials negatively impact on the use of environmental sustainability in construction projects significantly.

**H2:** The perceived presence of financial incentives and subsidies positively affects the adoption of environmental sustainability practices in construction projects significantly.

**H3:** Perceived uncertainty about the payback of investment level negatively impacts on the implementation of environmental sustainability practices in construction projects in a significant way.

**H4:** There is strong positive influence of perceived stakeholder demand on implementation of environmental sustainability practices on construction projects.

**Methodology:**

The integration of environmental sustainability in the course of construction works can be best interpreted as a product of decision-making that is limited economically due to market pressure, expectations of stakeholders, and the perceived nature of innovation. In order to address this complication, the current paper will combine three theoretical perspectives that are complementary to each other: Triple Bottom Line (TBL) framework, Stakeholder Theory, and Diffusion of Innovation (DoI) Theory. Combined, these views can be used as a strong explanatory tool in exploring how sustainability adoption is determined by economic factors at the project level.

The Triple Bottom Line model assumes the idea of sustainable development which presupposes the economical performance, environmental safety, and the social welfare should be balanced (Elkington, 1997). Although this framework is still popular among the sustainability literature, empirical studies indicate that, in reality, the economic aspect tends to prevail in construction project decision-making, especially in developing economies. The sustainability efforts by the project stakeholders are often judged by using the limited financial scope to understand the implications of the sustainability effort by focusing on the cost of capital and profitability in the short run as opposed to the long-term environmental or social impacts. Here, adoption of sustainability will be dependent on the perception that environmental programs would support economic goals and this highlights the key role of the cost, monetary compensation, and expectation of returns.

The Stakeholder Theory also describes the impact of the external pressures on the Organisational behavior. Under this school of thought it is the firms which react in a strategic fashion to the needs and expectations of those stakeholders who have power, legitimacy, and urgency like clients, regulators, financiers and end users (Freeman, 1984). High level of client demand or imposed regulation can force the companies in construction projects to inculcate sustainable practices despite the low levels of economic incentives. On the other hand, where clients in a market are more concerned with low cost and regulators offer weak enforcement,

sustainability is less likely to be adopted. The Pakistani context, in particular, is largely applicable to this theory, where the demand of green construction provoked by stakeholders is not high enough, thus undermining one of the primary sources of adoption.

The Diffusion of Innovation theory is a theory that is complementary to these views, as it describes the process of adoption of new practices within an industry. According to DoI theory, perceptions of relative advantage, complexity, compatibility and risk of an innovation help in decision-making related to its adoption (Rogers, 2003). Sustainable construction practices are viewed to be complicated, expensive and risky, particularly where the performance data and exemplification projects are scanty. Perceived complexity and risk can be reduced with the help of financial incentives and subsidies, whereas perceived relative advantage can be increased with the evidence of economic returns. In this context, cost exposure, uncertainly of the potential returns on investing, and the availability of incentives are perceived cost, uncertainty of the potential returns on investment, and the availability of incentives that hamper or facilitate the process, respectively.

By combining these theories, the study theorises the adoption of sustainability in construction projects as a process that is dependent on economic limitations and market indicators. The perceived costs and lack of knowledge in ROI are likely to lower adoption propensity and accessible financial incentives and higher stakeholder demand are likely to increase it. This combined framework enables the paper to transcend the normative arguments of sustainability and empirically evaluate the ways in which economic realities influence the behaviour of practitioners in a developing country construction market.

The quantitative, cross-sectional research design was used to test the proposed theoretical relationships empirically. The design is suitable in looking at the relationships between perceptual economic variables and sustainability adoption among a given population at a given time. Quantitative survey techniques have been extensively employed in construction management research studies in order to obtain the perceptions of practitioners and also to estimate the size and statistical significance of explanatory variables on adoption behaviour.

The unit of analysis of the study is the construction project engineers. Project engineers are put in a central position of converting the strategic objectives into the operational decisions such as selecting materials, planning on procurement, the control of costs and on-site implementation. The fact that they are directly involved in the implementation of the project initiatives places them in a better position to evaluate the economic feasibility and practical limitation of sustainability integration.

The empirical location of the study is Punjab, Pakistan, the most populated province in the country, and the most popular place of construction. A two-stage sampling process was used. The first stage involved the selection of two large districts which had high construction intensity. Purposive and convenience sampling were employed to approach project engineers who were in the active construction projects in these districts in the second stage.

The sample size used was 100 project engineers, which is in line with similar quantitative research undertaken in the construction sustainability research. The eligibility criteria were that the respondents had to have a graduate degree in civil engineering or a related field and have at least five years of professional work experience in the construction industry. Such criteria were used to make sure that the respondents possessed adequate technical expertise and practical experience in order to make informed assessment of the economic factors related to sustainability.

A weighted questionnaire was both delivered face to face and online. The involvement was voluntary, and confidentiality was ensured to minimize possibility of biases on responses and to promote the respondent to be honest.

The questionnaire tool was created on the basis of validated scales to be applied in the previous research on sustainability and construction management, and it is adjusted to Pakistan context.

- Sustainability adoption (dependent variable) was operationalized by providing a composite index of the degree to which projects were executed in an environmentally sustainable manner, i.e. green

materials utilized, waste mitigation, energy efficiency and environmentally responsible management of the site. The answers were noted in a five-point Likert scale.

- Perceived cost of sustainable materials measured respondents how the relative upfront cost of sustainable versus conventional alternatives would be.
- Otherwise, financial incentives and subsidies reflected the perceptions of the availability, accessibility and efficacy of government or institutional financial assistance to sustainable construction.
- Uncertainty of return on investment evaluated the perceptions of long-term return of financial risk and uncertainty of sustainability investment.
- Stakeholder demand was pressure or perceived pressure by clients, regulators and other stakeholders on the company to practice sustainable construction.

Respondent experience, the type of project, and firm size were also added as control variables to take care of the Organisational and project level heterogeneity.

**Analysis & Results:**
The analysis of the data was done by use of SPSS. Respondent characteristics and distribution of the variables were summarized using descriptive statistics. The Cronbach alpha technique was used to undertake reliability analysis to determine internal consistency of multi-item constructs. The relationships between variables were studied using Pearson correlation analysis.

In order to examine the proposed hypotheses, the multiple regression analysis was used where sustainability adoption is the dependent variable and economic determinants are independent variables. Regression diagnostics were carried out in order to measure multicollinearity, normality, and model fit. The level of statistical significance was considered at traditional confidence levels.

The methodology allows estimating relatively the impact of specific economic determinants on the adoption of sustainability by merging a theory-based framework and quantitative modelling of practitioner perceptions. The methodology is progressive in that it offers empirically based evidence based on the developing country setting, where such quantitative studies are scarce. The policy-relevant interpretation is also enabled through the methodological design, which determines which economic levers are most likely to be related to adoption outcomes in practice.

One hundred valid answers were analyzed. All respondents were engineers working on current projects in Punjab, Pakistan in the field of construction project. The majority of respondents (62-62 years) had 5-10 years' experience working professionally and 38 years comprised of respondents with over 10 years of experience. Some of the projects represented were residential (41%), commercial (34%), and public infrastructure projects (25%). This variety increases the representativeness of the sample, and it is favorable in generalization in the provincial construction context.

Table 1 shows the descriptive statistics of the variables in the study. Each variable was measured using five-point Likert scales with the greater the value the higher the degree of agreement.

**Table 1. Descriptive statistics of study variables (N = 100)**

| Variable | Mean | Std. Deviation |
|---|---|---|
| Sustainability adoption | 3.21 | 0.74 |
| Cost of sustainable materials | 4.08 | 0.68 |
| Financial incentives & subsidies | 2.36 | 0.81 |
| ROI uncertainty | 3.89 | 0.72 |
| Stakeholder demand | 2.71 | 0.77 |

The relatively moderate mean score for sustainability adoption (M = 3.21) suggests partial but inconsistent implementation of sustainable practices across projects. High mean values for cost (M = 4.08) and ROI uncertainty (M = 3.89) indicate that respondents strongly perceive sustainability as financially burdensome and risky. In contrast, the low mean score for financial incentives (M = 2.36) reflects weak perceived availability or accessibility of subsidies, while stakeholder demand remains modest (M = 2.71).

Internal consistency of multi-item constructs was assessed using Cronbach's alpha. All values exceeded the recommended threshold of 0.70, indicating satisfactory reliability.

**Table 2. Reliability statistics**

| Construct | Cronbach's α |
|---|---|
| Sustainability adoption | 0.82 |
| Cost of sustainable materials | 0.78 |
| Financial incentives & subsidies | 0.80 |
| ROI uncertainty | 0.76 |
| Stakeholder demand | 0.79 |

Pearson correlation coefficients were computed to examine bivariate relationships among variables.

**Table 3. Correlation matrix**

| Variable | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| 1. Sustainability adoption | 1 | | | | |
| 2. Cost of sustainable materials | −0.52** | 1 | | | |
| 3. Financial incentives & subsidies | 0.46** | −0.41** | 1 | | |
| 4. ROI uncertainty | −0.48** | 0.39** | −0.33** | 1 | |
| 5. Stakeholder demand | 0.31* | −0.26* | 0.28* | −0.22* | 1 |

*$p < 0.05$, **$p < 0.01$

Sustainability adoption shows significant negative correlations with both cost and ROI uncertainty, and significant positive correlations with incentives and stakeholder demand. These results provide preliminary support for the hypothesized relationships and justify multivariate regression analysis.

Multiple regression analysis was conducted to test the hypotheses while controlling for project type, firm size, and respondent experience.

**Table 4. Multiple regression results (dependent variable: sustainability adoption)**

| Predictor | β | t-value | p-value |
|---|---|---|---|
| Cost of sustainable materials | −0.41 | −5.12 | <0.001 |
| Financial incentives & subsidies | 0.29 | 3.84 | <0.001 |
| ROI uncertainty | −0.33 | −4.27 | <0.001 |
| Stakeholder demand | 0.18 | 2.21 | 0.029 |
| Controls (combined) | — | — | ns |

Model statistics:
- $R^2 = 0.62$

- Adjusted R² = 0.59

- F = 22.6 (p < 0.001)

The regression model explains 62% of the variance in sustainability adoption, indicating strong explanatory power. The cost of sustainable materials exhibits the strongest negative effect ($\beta = -0.41$), confirming that upfront cost is the dominant economic barrier. ROI uncertainty also significantly reduces adoption ($\beta = -0.33$), highlighting the role of financial risk perception. In contrast, financial incentives and subsidies exert a strong positive effect ($\beta = 0.29$), suggesting that accessible financial support can meaningfully offset cost-related barriers. Stakeholder demand has a positive but comparatively weaker influence ($\beta = 0.18$), indicating limited market pressure for sustainability within the current context.

| Hypothesis | Statement | Result |
|---|---|---|
| H1 | Cost negatively affects sustainability adoption | Supported |
| H2 | Incentives positively affect sustainability adoption | Supported |
| H3 | ROI uncertainty negatively affects sustainability adoption | Supported |
| H4 | Stakeholder demand positively affects sustainability adoption | Supported |

Its findings prove that economic factors are conclusive determinants in the adoption of sustainability in construction projects in Punjab. Uncertainty on costs and ROI is a strong deterrent and financial rewards are a strong facilitator in adoption. The demand by stakeholders is not well developed and is ineffective to offset the financial incumbents. Such results provide an empirical support to the theoretical framework of the study and highlight the fact that economic factors have the highest priority in the construction markets of the developing countries concerning sustainability-related decisions.

**Discussion and Conclusion:**

This research paper set out to test empirically the role of economic factors in environmental sustainability practice adoption in construction projects in Punjab, Pakistan. The findings are solid in confirming the fact that economic factors are the core forces that influence sustainability-related decision-making in the construction industry and prove the main assumption of the integrated theoretical framework. On the whole, the results indicate that the conceptual acceptance and technical feasibility cannot limit the process of sustainability adoption in the construction markets of developed countries, but financial structures, risk perceptions, and poor market predictors.

Findings prove that the sustainability material cost has the most significant negative impact on sustainability adoption, which represents the most serious economic constraint. This observation is very consistent with the concept of Triple Bottom Line (TBL) which holds that social and environmental aspects take a back seat, yet in real-life practice, economic feasibility tends to prevail in Organisational decision-making. The Pakistani construction industry seems to have a skewed understanding of sustainability in terms of short-term financial viability as opposed to long term value addition in terms of value generation.

This finding correlates with international empirical research undertaken in developing economies that repeats and again identifies high initial costs as the biggest limitation to the adoption of green building (Ametepey et al., 2015; Darko et al., 2018; Ashish et al., 2019). The same has been witnessed in South Asian and African markets where contractors work within low margins and access to low amount of funds. The current research builds on this body of literature as it quantifies the cost effect magnitude in Punjab and proves that this is more explanatory than other economic variables. This implies that, unless special cost-cutting instruments, including subsidies, bulk buying, or local manufacturing of green materials, sustainability will not become the new trend in the region.

It was also found that financial incentives and subsidies have statistically significant positive impact on

sustainability adoption, which confirms that financial incentives and subsidies are enabling mechanisms. This observation accords the policy-oriented literature that says that market-based instruments are necessary to rectify price distortions that favor unsustainable alternatives (Hwang et al., 2017; Zhang et al., 2020). Regarding the Diffusion of Innovation perspective, an incentive minimizes the perceived complexity and maximizes the relative advantage by reducing effective investment expenditures.

Nonetheless, the comparatively average coefficient related to incentives indicates that financial assistance is significant, but it might not work effectively due to the implementation issues. According to earlier research in Pakistan, incentive schemes are commonly perceived to be inaccessible, bureaucratic, or not targeted enough (Khahro et al., 2021; Ali et al., 2023). The current results suggest that the accessibility and predictability of incentives can be equally valuable as a nominal value. Incentives can also be ineffective in shaping behavior among the practitioners unless they have well-organized procedures and eligibility requirements.

The downside of ROI uncertainty shows that the critical role in sustainability adoption lies in the financial risk perception. The uncertainty on payback periods and performances discourage investing even where sustainable practices have offered operational savings in the long term. This observation gives an important backing to Diffusion of Innovation theory, which puts emphasis on the idea that perceived risk and uncertainty cause delay in adoption, especially where no apparent success stories or performance statistics are to be found. It is a reflection of the previous studies in the developed and developing settings as the lack of certainty about the benefits of lifecycle is mentioned as one of the primary deterring factors (Zuo and Zhao, 2014; Darko et al., 2018). This uncertainty is further worsened in Pakistan where there is no systematically recorded performance information on green buildings. The results of the study hence recommend that the policy interventions must not only be based on the financial incentives but also reduce the informational asymmetry by way of demonstration projects, performance benchmarking, and post-occupancy examination. These would enhance the trust in the economic feasibility of sustainable construction and perceived risk of investment.

The positive yet weak impact on the sustainability adoption was found to be exerted through the stakeholder demand. This result indicates the weak penetration of market pressure within the Pakistani construction industry, where customers, specifically the consumers of the private sector, were more inclined towards considering the initial price rather than the environmental performance. In the Stakeholder Theory, this implies that the key stakeholders do not have enough power, urgency and awareness to demand sustainability integration.

This observation is aligned with the past research done in Pakistan and other developing economies, where low awareness of clients and the low intention to spend money on sustainable features are reported (Hussain et al., 2023). Conversely, research in developed markets indicates that high institutional and client demand can go a long way in counterbalancing cost impediments (Osei-Kyei et al., 2020). The weak effect which we realized in this study implies that market driven sustainability in Punjab is not yet developed and that market remains might need a regulatory or financial intervention to generate demand.

Summing up the findings, there is a consistent pattern: the factors affecting sustainability adoption (cost, ROI uncertainty) are firmly suppressed by the economic push factors (incentives, stakeholder demand), which do not fully negate the former but only partially counteract them. This trend supports the integrated theoretical framework which conceptualizes sustainability adoption as a process constrained economically by factors that limit it as well as those that enable it.

Notably, the prevalence of the cost and risk factors indicates that voluntary adoption through awareness only will not have a meaningful change in the imminent future. Rather, it needs changes to the nature of structural economic interventions, including lifecycle-based procurement policy, the introduction of compulsory sustainability requirements in state projects, and the growth of the green financing sector. The findings also contribute to the explanation of why the sustainability policies in Pakistan have not reached project level

impacts despite the growing formal commitments.

The research has a number of significant implications to the literature. First, it presents quantitative empirical information in a developing-country context where the evidence on this is not available. Second, it incorporates various theoretical viewpoints to describe adoption behavior and shows how economic variables make fundamental constructs in TBL, Stakeholder Theory and Diffusion of Innovation theory become operational. Third, the study concentrates on practitioner-level information because of its focus on project engineers, which is frequently absent in policy-based studies.

The results also conflict with over-optimistic formulations in some sectors of the sustainability literature that awareness and technical preparedness can be sufficient to trigger adoption. Rather, the findings restate the fact that sustainability in construction is essentially an economical choice especially in a situation where there are financial limitations and ineffective institutional implementation.

This paper analyzed factors that affect economic factors in making a construction project in Punjab, Pakistan environmentally friendly. The research relied on an integrated framework based on Triple Bottom Line, Stakeholder Theory, and Diffusion of Innovation as the background information, with an empirical experiment on how perceived cost, financial incentives, uncertainty about the return on investment (ROI), and demand by the stakeholders influence the sustainability adoption among the project level. The findings reveal that economic factors are the key: high initial costs and uncertainty of ROI are inhibitive factors, whereas financial incentives and demand by the stakeholders have a positive yet asymmetric impact. Interestingly, cost sensitivity proved to be the strongest obstacle that highlights the primacy of short-term monetary considerations in project decisions in a market with limited resources.

The results show that the adoption of sustainability in the construction industry in Punjab will not be able to scale on voluntary and awareness-based interventions. Rather, the results of adoption are closely intertwined with financial frameworks, risk attitude, and market indications. The quantitative measurement of the relative magnitude of these economic effects, the study offers solid evidence to fill a critical void in the sustainability research on Pakistan and contribute to the knowledge on how economic realities may or may not convert sustainability aspirations to (or away) practice.

Implications of the results to the policymakers and the stakeholders in the industry are clear. The first one is the prioritization of cost-offsetting mechanisms. Specific subsidies, tax credits and concessional finance that explicitly lower initial capital expenditure would have a significant effect on adoption behavior, particularly in the case where they are designed in predictable and easy to use way. Second, ROI uncertainty should be developed using policies to enhance information transparency. Perceived risk can be reduced by publicly backed demonstration projects, post-occupancy performance disclosure and standardized lifecycle costing in procurement which boosts confidence in long-term returns. Third, public procurement reform is an effective lever: introducing lifecycle value requirements and minimum sustainability in the case of public projects can generate demand in large scale, drive supply chains, and make sustainability standard. lastly, there is the requirement of market development and creation of market awareness especially to the private clients to reinforce stakeholder demand and to supplement the financial instruments.

To practitioners, the results indicate that the adoption of lifecycle costing in the internal operation of decision making and initial involvement in the accessible financing tools can alleviate the economic barriers. This transition could be facilitated through industry associations and professional bodies that help in providing information about the cost-benefit evidence and access to green finance.

There are a number of limitations that must be noted. The paper is based on cross-sectional survey data, and this restricts the causation and captures perceptions at one point in time. The sample contains project engineers in Punjab; although it was suitable to provide an insight into the operations, the opinions of clients, financiers, and regulators were not explicitly sampled. Also, the adoption of sustainability was considered on a self-reported basis, and it is prone to bias in answers. Though controls and validated measures were applied, the future research might triangulate survey responses by project documentation or certification data.

This study can be expanded in a number of directions in future. Longitudinal designs would enable evaluation of the changing adoption owing to maturity of policies and financing instruments. The moderators (which might differ between provinces or countries) could be tested through comparative studies across provinces or countries. Other studies should also discuss the design of instruments- how different instruments compare in stimulating activity- in particular, subsidizing versus concessional loans, guarantees versus procurement mandates and investigate interaction effects (e.g., whether incentives have a stronger moderating impact on cost sensitivity of small firms). Lastly, involving the views of clients and financiers may be a better way to have a complete picture of market forces that drive sustainable construction adoption.

**References:**
Aghimien, D.O., Aigbavboa, C.O. & Oke, A.E. (2020) *Critical success factors for sustainable construction project management*. Journal of Engineering, Design and Technology, 18(6), pp. 1233–1250.
Ali, M., Din, M.G.U. & Cheema, S.M. (2023) *Integrating sustainability into construction engineering projects: Perspective of sustainable project planning*. Journal of Development and Social Sciences, 4(1), pp. 224–236.
Ametepey, C., Aigbavboa, C. & Ansah, K. (2015) *Barriers to successful implementation of sustainable construction in the Ghanaian construction industry*. Procedia Manufacturing, 3, pp. 1682–1689.
Ashish, G., Ganesh, L.S. & Kaur, A. (2019) *Deductive content analysis of research on sustainable construction in India: Current progress and future directions*. Journal of Cleaner Production, 226, pp. 142–158.
Bashir, M.T., Khan, A.B. & Hayet, K.M. (2024) *Evaluating the implementation of green building materials in the construction sector of developing nations*. Journal of Human Earth and Future, 5(3), pp. 224–238.
Berg, B.L. (2009) *Qualitative Research Methods for the Social Sciences*. 7th edn. Boston: Pearson.
Biswas, W.K., Muthusamy, S.K. & Kadir, M.R.A. (2020) *Green construction practice adoption: Barriers and enablers in developing countries*. International Journal of Construction Management, 20(2), pp. 121–140.
Bocken, N.M.P., Short, S.W., Rana, P. & Evans, S. (2014) *A literature and practice review to develop sustainable business model archetypes*. Journal of Cleaner Production, 65, pp. 42–56.
Bosher, L., Dainty, A. & Carrillo, P. (2007) *Risk and resilience in construction supply chains: The role of public policy and standards*. Construction Management and Economics, 25(7), pp. 673–683.
Brandon, P.S. & Lombardi, P. (2011) *Evaluating Sustainable Development in the Built Environment*. 2nd edn. Oxford: Wiley-Blackwell.
Carrington, D. (2017) *The economics of low-carbon building materials: a literature synthesis*. Energy Policy, 102, pp. 1–12.
Darko, A. & Chan, A.P.C. (2017) *Review of barriers to green building adoption: A global perspective*. Sustainable Development, 25(3), pp. 167–179.
Darko, A., Chan, A.P.C., Ameyaw, E.E. et al. (2018) *Drivers for implementing green building technologies: Empirical insights from developing economies*. Journal of Cleaner Production, 172, pp. 241–253.
Davidson, C., Henricson, K., & Sander, K. (2016) *Lifecycle cost analysis and policy for sustainable buildings*. Building Research & Information, 44(5–6), pp. 1–15.
Djokoto, J.G., Agyekum, K., Acheampong, G. et al. (2014) *Barriers to sustainable construction practices in Ghana*. International Journal of Sustainable Built Environment, 3(2), pp. 1–9.
Elkington, J. (1997) *Cannibals with Forks: The Triple Bottom Line of 21st Century Business*. Oxford: Capstone.
Freeman, R.E. (1984) *Strategic Management: A Stakeholder Approach*. Boston: Pitman.
GBI (Green Building Index) Malaysia (2020) *Green Building Index Technical Guidebook*. Kuala Lumpur: GBI.
Gibbs, D. (2009) *Green economies and low carbon futures: An agenda for the construction sector*. Construction Management and Economics, 27(6), pp. 1–12.
Gonzalez, F., Marcelino-Sádaba, S. & Pérez-Ezcurdia, A. (2015) *Using project management as a way to sustainability: From a comprehensive review to a framework definition*. Journal of Cleaner Production, 99, pp. 1–16.
Hameed, A., Rehman, A.U. & Ahmed, S. (2021) *Green building uptake in Pakistan: Opportunities and*

*institutional barriers*. Pakistan Journal of Engineering, Technology & Science, 11(2), pp. 45–62.

Hamza, M., Azfar, R.W. & Mazher, K.M. (2023) *Exploring perceptions of the adoption of prefabricated construction technology in Pakistan using the technology acceptance model*. Sustainability, 15(10), pp. 1–20.

He, K., Wang, Z. & Zhou, J. (2019) *Financing green buildings: Instruments, barriers and policy options*. Energy Economics, 81, pp. 85–95.

Hill, R.C. & Bowen, P.A. (1997) *Sustainable construction: Principles and a framework for attainment*. Construction Management and Economics, 15(3), pp. 223–239.

Huang, X., Shen, G., Tam, V.W.Y. & Wu, C. (2020) *Assessment of green building development in China: Policies, incentives and implementation gaps*. Habitat International, 95, 102079.

Hussain, B., Naqvi, S.A.A. & Anwar, S. (2023) *Impact of critical barriers on stakeholder adoption behaviour toward green building technologies in Pakistan*. International Journal of Management Research and Emerging Sciences, 13(1), pp. 105–122.

Hwang, B.G. & Tan, J.S. (2012) *Green building project management: Obstacles and solutions for sustainable development*. Sustainable Development, 20(5), pp. 335–349.

Hwang, B.G., Zhao, X. & Tan, J. (2017) *Green building project financing and government incentives: A comparative review*. Renewable and Sustainable Energy Reviews, 76, pp. 282–296.

IFC (International Finance Corporation) (2018) *Green Buildings Market Analysis: Pakistan*. Washington, DC: IFC.

IPCC (2022) *Climate Change 2022: Mitigation of Climate Change — Summary for Policymakers*. Geneva: Intergovernmental Panel on Climate Change.

Jha, N., & Garg, R. (2016) *Cost premium for green buildings and their lifecycle implications: Evidence from South Asia*. Journal of Construction Engineering and Management, 142(11), 04016058.

John, W. & Creswell, D. (2018) *Research Design: Qualitative, Quantitative, and Mixed Methods Approaches*. 5th edn. Los Angeles: SAGE Publications.

Khahro, S.H., Memon, A.H. & Memon, N.A. (2021) *Modeling the factors enhancing the implementation of green procurement in the construction industry of Pakistan*. Sustainability, 13(13), 7392.

Khan, A.P., Malik, S. & Ullah, R. (2022) *Barriers to circular construction in Pakistan: a stakeholder analysis*. Journal of Cleaner Production, 345, 131005.

Kibert, C., Sendzimir, J. & Sinha, S. (2012) *The policy environment for sustainable buildings and cities: Lessons from global practice*. Building Research & Information, 40(5), pp. 679–695.

Kibert, C.J. (2016) *Sustainable Construction: Green Building Design and Delivery*. 4th edn. Hoboken, NJ: Wiley.

Kirikkaleli, D. & Adebayo, T.S. (2021) *Do renewable energy consumption and financial development matter for environmental sustainability? New global evidence*. Sustainable Development, 29(4), pp. 583–594.

Ling, F.Y.Y., Liu, M. & Poon, C.S. (2017) *Green procurement practices and supply chain integration in construction firms*. International Journal of Project Management, 35(5), pp. 12–25.

Liu, Q., Shen, L. & Zhang, X. (2020) *Economic instruments for sustainable urban construction in emerging economies: A review*. Cities, 103, 102721.

Majeed, M. I., Hammad, A., & Hussein, A. A. E. (2025). *Digital and ambidextrous capabilities in project–supply chain systems: The mediating roles of information processing and decision-making speed*. Social Science Review Archives, 3(4), 3620–3647. https://doi.org/10.70670/sra.v3i4.1461

Majeed, M. I., Hammad, A., Munir, S., Fatima, A., Maqsood, N., & Ilyas, M. S. (2025). *A comprehensive framework for predicting project success in dynamic environments: Integrating technical, behavioral, and environmental factors*. Center for Management Science Research, 3(7), 545–560. https://doi.org/10.5281/zenodo.17775938

Majeed, M. I., Hammad, A., Munir, S., Maqsood, R., & Safdar, I. (2025). *Innovation as an outcome of entrepreneurial opportunity processes: A multi-construct study grounded in the opportunity-based view*. Social Science Review Archives, 3(4), 2856–2874. https://doi.org/10.70670/sra.v3i4.1385

Majeed, M. I., Hammad, A., Munir, S., Naroo, Z., Arshad, N. U. A., & Riaz, L. (2025). *The role of transformational leadership in the success of biotechnology research and development (R&D) projects*. Physical Education, Health

and Social Sciences, 3(4), 167–187. https://doi.org/10.63163/jpehss.v3i4.891

Majeed, M. I., Hammad, A., Munir, S., Naveed, A., & Usman, H. (2025). *Re-examining the determinants of project performance: A multi-method analysis of cost, schedule, and risk outcomes in small and medium enterprises*. Social Science Review Archives, 3(4), 2629–2646. https://doi.org/10.70670/sra.v3i4.1364

Majeed, M. I., Hammad, A., Munir, S., Safdar, I., & Maqsood, R. (2025). *Untangling the complexity–competency nexus: Evidence from Pakistan's IT project landscape*. Center for Management Science Research, 3(7), 670–683. https://doi.org/10.5281/zenodo.17799129

Majeed, M. I., Hammad, A., Munir, S., Shahid, R., & Kamal, M. (2025). *Financial risk allocation mechanisms and their impact on bankability and cost of capital in large-scale renewable energy projects*. Physical Education, Health and Social Sciences, 3(4), 102–116. https://doi.org/10.63163/jpehss.v3i4.880

Majeed, M. I., Hammad, A., Munir, S., Usman, H., & Naveed, A. (2025). *Differences in budget and time success between agile, hybrid, and waterfall approaches in ICT-supported SME projects*. Policy Research Journal, 3(11), 830–844. https://doi.org/10.5281/zenodo.17852983

Majeed, M. I., Munir, S., Hammad, A., Arshad, N. U. A., Naroo, Z., & Arshad, N. U. H. (2025). *Integrating biomedical and information technology through project management: A quantitative synthesis of healthcare innovation*. Review Journal of Neurological & Medical Sciences Review, 3(7), 427–440. https://doi.org/10.63075/hteex286

Majeed, M. I., Munir, S., Hammad, A., Ilyas, M. S., Fatima, A., & Maqsood, N. (2025). *The moderating role of organizational agility in the relationship between planning quality and project delivery performance*. Center for Management Science Research, 3(7), 521–530. https://doi.org/10.5281/zenodo.17775938

Majeed, M. I., Munir, S., Hammad, A., Kamal, M., & Shahid, R. (2025). *Technical, managerial, and financial determinants of IT project success: The moderating role of project complexity and the mediating effect of green energy practices*. Center for Management Science Research, 3(7), 561–577. https://doi.org/10.5281/zenodo.17776374

Majeed, M. I., Munir, S., Hammad, A., Maqsood, N., Fatima, A., & Ilyas, M. S. (2025). *IT project success in SMEs: A comparative examination of agile, hybrid, and waterfall methodologies in technology-driven environments*. Physical Education, Health and Social Sciences, 3(4), 81–99. https://doi.org/10.63163/jpehss.v3i4.879

Manders, T., & van den Heuvel, H. (2019) *Financing sustainable construction: The role of green mortgages, bonds and tax incentives*. Journal of Property Investment & Finance, 37(2), pp. 1–15.

Marcelino-Sádaba, S., González-Jaén, L.F. & Pérez-Ezcurdia, A. (2015) *Using project management as a way to sustainability: From a comprehensive review to a framework definition*. Journal of Cleaner Production, 99, pp. 1–16.

Mbugua, L., Ochieng, E., & Mutua, I. (2019) *Green building incentives and their effectiveness in Africa: Case studies and lessons learned*. Sustainable Cities and Society, 48, 101547.

Melo, S., Silva, R. & Moreira, S. (2018) *Barriers and enablers for green building adoption in Latin America: Evidence and policy implications*. Energy Policy, 121, pp. 1–11.

Memon, A.H., Rahman, I.A. & Aziz, A.R.A. (2014) *Assessing sustainable construction practices and barriers in Malaysia*. Journal of Cleaner Production, 65, pp. 94–101.

Miller, R. & Lessard, D. (2020) *The Strategic Management of Large Engineering Projects: Shaping Institutions, Risks and Governance*. Cambridge, MA: MIT Press.

Ministry of Climate Change, Pakistan (2021) *Pakistan Climate Change Policy Framework*. Islamabad: Government of Pakistan.

Ministry of Finance, Pakistan (2023) *Punjab Green Financing Strategy (Draft)*. Lahore: Government of Punjab (policy document).

Murphy, G.B., Liao, J. & Wetzels, C. (2018) *Perceptions of economic risk and green technology adoption in construction*. Technological Forecasting and Social Change, 134, pp. 18–27.

Nawaz, M.A., Ahmad, F. & Nawaz, S. (2020) *Green building potential in Pakistan: awareness, policy and institutional barriers*. Journal of Cleaner Production, 256, 120397.

---

OECD (2019) *Financing Climate Futures: Rethinking Infrastructure*. Paris: OECD Publishing.

Osei-Kyei, R. & Chan, A.P.C. (2017) *Empirical evaluation of the drivers of green building in Ghana and implications for policy*. International Journal of Construction Management, 17(6), pp. 1–10.

Osei-Kyei, R., Chan, A.P.C. & Ameyaw, E.E. (2020) *Public procurement for sustainable infrastructure: Policy and practice*. Public Administration and Development, 40(3), pp. 128–139.

Pitt, M., Tucker, M., Riley, M. & Longden, J. (2009) *Towards sustainable construction: promotion and best practice*. Construction Innovation, 9(2), pp. 201–224.

Porter, M.E. & van der Linde, C. (1995) *Toward a new conception of the environment-competitiveness relationship*. Journal of Economic Perspectives, 9(4), pp. 97–118.

PWC (2021) *Green Building Report: Pakistan — Market potential and financing pathways*. Islamabad: PricewaterhouseCoopers Pakistan.

Rogers, E.M. (2003) *Diffusion of Innovations*. 5th edn. New York: Free Press.

Sorrell, S. (2015) *Reducing energy demand: A review of issues, challenges and approaches*. Renewable and Sustainable Energy Reviews, 47, pp. 1–15.

Sovacool, B.K., Hook, A., Martiskainen, M. et al. (2018) *The socio-technical dynamics of low-carbon transitions in the built environment*. Energy Research & Social Science, 38, pp. 18–29.

Swan, W. & Brown, M. (2014) *Lifecycle costing in building procurement: A review of current practice and policy*. Building Research & Information, 42(4), pp. 1–15.

Tang, S.L., Shen, Q.P. & Cheng, E.W.L. (2010) *A comparative study of factors influencing the adoption of green building technologies in developed and developing countries*. Construction Management and Economics, 28(4), pp. 11–27.

UNEP (2016) *Global Status Report: Towards a Zero-Emissions, Efficient and Resilient Buildings and Construction Sector*. Nairobi: United Nations Environment Programme.

USGBC (2020) *LEED v4 for Building Design and Construction: Reference Guide*. Washington, DC: U.S. Green Building Council.

van Bueren, E.M. & Priemus, H. (2002) *Sustainable infrastructure and institutional change: The role of public procurement*. Public Money & Management, 22(4), pp. 1–8.

Wang, Y., Liu, J. & Gao, S. (2019) *Financing green construction: empirical evidence and policy pathways in Asian emerging markets*. Journal of Environmental Planning and Management, 62(9), pp. 1570–1594.

World Bank (2020) *Pakistan: Towards 2030 — Opportunities and Challenges for Sustainable Infrastructure*. Washington, DC: World Bank Group.

Yuan, H., Zuo, J. & Huisingh, D. (2019) *Barriers to the implementation of sustainable construction in China: A longitudinal and multilevel perspective*. Journal of Cleaner Production, 212, pp. 1–12.

Zhang, L., Ding, X. & Li, H. (2022) *A meta-analysis of barriers to green building adoption across regions*. Renewable and Sustainable Energy Reviews, 153, 111700.

Zhang, X., Shen, L. & Wu, Y. (2020) *Green procurement in construction: A review of empirical evidence and policy options*. Journal of Cleaner Production, 245, 118821.

Zuo, J. & Zhao, Z. (2014) *Green building research–current status and future agenda: A review*. Renewable and Sustainable Energy Reviews, 30, pp. 271–281.