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From Green Construction to Sustainable Cities: Evaluating the Contribution of Green Buildings to Urban Sustainability

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Abstract
Green building practices connect project decisions with urban sustainability aims, although professional beliefs do not establish city-wide resource outcomes. This paper analyses 178 rec-ords in a supplied Pune architect-response CSV and places the findings alongside verified liter-ature and institutional secondary evidence. Reported green practices are represented by the arithmetic mean of Q1 to Q4, perceived urban-sustainability contribution by the separate Q5 item, and barriers by the mean of Q6 to Q10. Each questionnaire statement is reported in its own frequency table with a separate interpretation. Pearson correlation indicates a positive as-sociation between the non-overlapping practice index and perception item, $r = 0.512$, with a one-sided $p < 0.001$. The revised second hypothesis concerns the mean barrier score relative to the neutral benchmark of 3. Its mean is 3.276, and the one-sample test gives $t(177) = 4.195$, with a one-sided $p < 0.001$. The results indicate a positive practice-contribution association alongside above-neutral perceived barriers. The hypotheses were adapted to the permitted pro-cedures before interpreting the recalculated results. Collection dates, recruitment and respond-ent independence are not established by the CSVs, and arithmetic indices are not treated as val-idated constructs. The findings describe the supplied response records and support subsequent operational verification rather than causal or representative conclusions.

Keywords: green buildings; urban sustainability; green practices; regulatory and financial barriers; Pune

Introduction

The building sector occupies a central position in contemporary debates on urban sustainability because construction and operation of buildings draw heavily on non-renewable energy and contribute substantially to greenhouse gas emissions. Green construction has therefore been promoted as a pathway through which individual projects can reduce environmental burdens while delivering healthier indoor environments. Yet the translation of green design intent into verified performance remains uneven, and the contribution of certified or nominally sustainable buildings to city scale outcomes is neither automatic nor well understood. This paper addresses that problem by examining how architects practising in Pune city perceive the contribution of green buildings to urban sustainability. Architects occupy a pivotal position in this translation because they select passive and active strategies, specify materials, coordinate certification requirements, and shape the briefs through which sustainability ambitions enter the built environment. Understanding their perceptions is therefore a necessary, though not sufficient, step in evaluating whether green construction accumulates into sustainable cities. The operational-performance concern is emphasized by Geng et al. (2019) and Amiri et al. (2019).

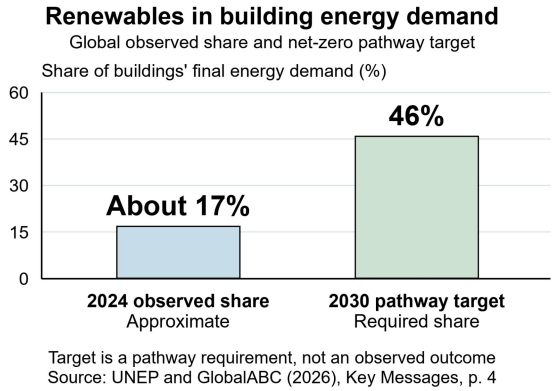

Figure 1. Approximate renewable share of global buildings' final energy demand: 17% observed in 2024 and 46% required for the 2030 pathway. Source: United Nations Environment Programme and Global Alliance for Buildings and Construction (2026), Key Messages, p. 4. The target is not a forecast or observed outcome.

The architectural mechanisms through which green buildings are expected to contribute to sustainability operate at several scales. Passive design remains foundational: orientation, massing, shading, natural ventilation, daylighting, and envelope performance determine loads before any mechanical system or renewable technology is specified. Digital tools, including energy simulation, daylight analysis, and life cycle assessment, extend these mechanisms by allowing designers to test alternatives, but such tools are only meaningful when their outputs are checked carefully and judged against actual energy use and measured comfort rather than accepted as predictions. Material selection, water sensitive design, and waste management during construction further extend the range of architectural levers. Certification frameworks formalise these mechanisms into scoreable criteria, which can discipline practice but can also encourage compliance oriented rather than performance oriented design. A central concern of this study is how architects in Pune weigh these mechanisms, how they reconcile passive fundamentals with digital workflows, and whether they regard certification as a proxy for performance or as one instrument among several.

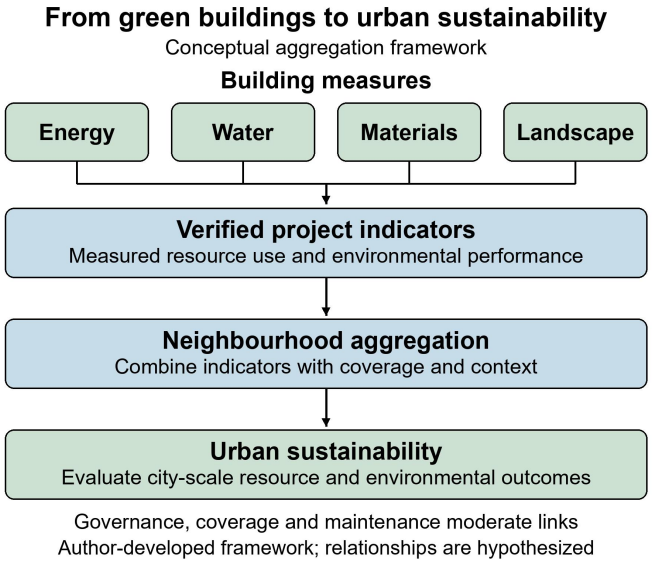

Figure 2. Proposed aggregation framework distinguishing building measures, verified indicators, neighbourhood aggregation and urban outcomes. Source: Author-developed conceptual framework. Governance, coverage and maintenance are proposed conditions, not estimated effects.

Pune is the stated geographic setting of the supplied architect questionnaire. Architectural judgements about code integration, heat-island design, water recycling and materials offer a professional perspective on sustainability priorities. Such responses do not directly measure urban energy demand, resource flows or environmental quality. The connection from building decisions to city outcomes requires further information about coverage, boundaries, maintenance and distribution. The source table records firm-size categories without employee thresholds, which provides an analytical grouping but requires caution in interpreting the categories as uniform organizational types.

The paper examines the correlation between reported green practices and perceived urban-sustainability contribution, and whether mean

barrier agreement exceeds the neutral benchmark of 3. It analyses 178 records from the supplied CSV using non-overlapping predictor and outcome items. Figure 1 provides verified external evidence; Figure 2 organizes the conceptual pathway. The two hypotheses use Pearson correlation and a one-sample t test respectively. Firm categories are reported descriptively, without claims about differences between groups.

2. Literature Review

Geng et al. (2019) review post-occupancy performance of green buildings across energy use, indoor environmental quality, and occupant satisfaction. The authors screened published articles and compared actual operating performance of green buildings in China and the United States using information collected from previous research. Findings indicate that green buildings generally outperform conventional counterparts in energy terms despite exceptional cases, that a significant gap exists between designed and operational energy consumption, that no clear relationship links actual energy use to certification level, and that occupant satisfaction tends to be higher, although US subjective evidence did not support that inference. This review is relevant to the present study because it cautions that perceptual assessments of green building performance may diverge from measured operational outcomes, a boundary that applies to architect-reported survey data.

Amiri et al. (2019) critically examine whether LEED-certified buildings are energy-efficient in practice. The authors conduct a critical analysis of the literature, selecting peer-reviewed articles from search results to discuss different aspects of LEED from the viewpoint of energy efficiency. The reviewed material shows no consensus: some articles link LEED certification to energy efficiency, while others disagree or take no position. The study concludes that the energy efficiency of LEED-certified buildings is questionable, particularly at lower certification levels, and recommends modifying the Energy and Atmosphere category. This paper is relevant to the present study because it highlights that certification-based perceptions of sustainability may not correspond to actual energy performance, a distinction that must be maintained when interpreting practitioner survey responses.

Trindade et al. (2017) analyse scientific studies addressing both environmental sustainability and the smart city concept in order to understand the relationship between the two. The authors employ a qualitative methodology through a systematic review of the literature examining the terms smart city and sustainability, drawing on three databases: Scopus, Science Direct, and Emerald Insight. The paper identifies information about researchers, models, frameworks, and tools focused on these themes and provides detailed information on recent scientific articles addressing smart cities and sustainability issues. The findings are intended to support scholars seeking background information and public managers considering practical application. This review is relevant to the present study as background for situating green building practices within broader urban sustainability agendas, while its scope remains conceptual rather than measurement-based.

Yigitcanlar et al. (2019) ask whether cities can become smart without being sustainable, addressing the limited evidence on how sustainability outcomes are incorporated or achieved within smart city initiatives. The authors undertake a systematic review of the smart and sustainable cities literature. The analysis highlights an expectation in the reviewed literature that cities should become sustainable first in order to be considered truly smart. Results identify major challenges in delivering sustainable outcomes: heavy technocentricity in smart city policies, complexities in smart city practices, and ad-hoc conceptualisation of smart city notions. The authors conclude that practice fails to incorporate an overarching sustainability goal and call for a post-anthropocentric approach. This paper is relevant as conceptual framing for the present study, while remaining a literature review rather than an empirical measurement source.

Chen et al. (2023) review green construction in the context of low-carbon cities, motivated by the need for the construction industry to pursue net-zero carbon emissions. The review covers history, carbon emissions, policies, models, life cycle assessment, and sustainable materials including biochar, bioplastic, agricultural waste, animal wool, fly ash, and self-healing concrete. The authors analyse emissions across the building life cycle and present national policy frameworks and technology roadmaps from the United States, Japan, China, and the European Union, highlighting plans for carbon neutrality in the building sector. This paper is relevant to the present study because it connects green construction practices to city-level decarbonisation goals, although its evidence concerns sectoral and policy analysis rather than practitioner perceptions of the kind provided in the survey file.

Sánchez Cordero et al. (2020) critically review green building rating systems within Europe and the new framework Level(s). The authors note that emissions from the building sector relate to energy consumption and other attributes including materials selection, waste management, transportation, and water consumption, and that the proliferation of rating systems makes it difficult for stakeholders to identify a suitable system for a specific project. The paper reviews BREEAM, DGNB, HQE, and LEED and performs a bottom-up comparison of the influence of Level(s) indicators on final scores, finding heterogeneous effects, with LEED and BREEAM most affected and DGNB most

aligned to the EU framework. This review is relevant to the present study because it underscores heterogeneity in how sustainability is assessed, a caution applicable to architect-reported perceptions of certification value.

Bungau et al. (2022) assess green buildings within the context of sustainable environment development, clarifying notions and principles of application while integrating green materials and circular economy into a technical-engineering framework. The authors observe that strategies applying the green building concept face limited public acceptance owing to technologies that still require optimisation, relatively low return on investment, and limited dissemination of information about the concept. The manuscript proposes a score assigned to different types of buildings based on the assessment of several specific parameters and aims to provide stakeholders, from designers to occupiers, with a coherent overview of the green building concept and its beneficial role for future use. This paper provides conceptual grounding for practitioner assessment, while its proposed scoring remains distinct from the descriptive survey indices used here.

Abd Rahman et al. (2026) comparatively analyse green building rating systems for performance-based contracting in Southeast Asian data centres. Green Building Rating Systems (GBRSs) are widely used to promote and guide sustainable development across the built environment, yet a significant gap remains between certification achievement and actual operational performance, limiting their ability to support Performance-Based Contracts (PBCs), particularly in the rapidly growing and energy-intensive data centre sector. The study evaluates the potential of GBRSs to support PBC implementation through a comparative content analysis of seven certification frameworks: LEED, EDGE, Green Building Index (GBI), GreenRE, MCMC MTSFB TC G004:2024, Greenship Data Center, and BCA-IMDA Green Mark. It compares certification criteria, scoring methodologies, assessment categories, and compatibility with PBC requirements, including measurable indicators, performance verification, monitoring capability, and contractual enforceability. Energy efficiency is the dominant assessment category across all frameworks, with Power Usage Effectiveness (PUE) the most widely adopted performance metric, although differences in scoring structures, category weightings, and performance thresholds limit regional harmonisation and benchmarking. The present study analyses architect questionnaire responses in Pune and does not treat this comparison of rating frameworks as a measured operational result.

Affolderbach and O'Neill (2023) examine everyday sustainability transitions through the use of green buildings, with attention to materialities, discourses, and lived sustainabilities. The abstract notes that in 2019 governments across Europe set the goal to achieve net-zero greenhouse gas emissions by 2050, and that the building sector, through its high share of energy use and carbon emissions, is seen as central in this endeavor. European Union and national regulation and incentive schemes provide an important context, yet how green building is realized often plays out at subnational spatial scales, including how green buildings are designed and embedded in existing regional and local infrastructures. The authors state that very little attention has been paid to post-occupancy studies and the practices of building users in enabling or constraining sustainability transitions, and that a fabric-only or technologically-focused approach will be insufficient. The article presents a research agenda on the entangled spatial dimensions of sustainability transitions. The present study analyses architect questionnaire responses in Pune on green-building practices, beliefs about contribution to urban sustainability, and regulatory or financial barriers.

Alawneh et al. (2019) investigate how energy efficiency in green buildings certified by the Leadership in Energy and Environmental Design (LEED) rating system contributes towards achieving United Nations (UN) Sustainable Development Goals (SDGs) in Jordan. Jordan faces stringent energy challenges mainly in the form of import dependence and escalating demand, and the building sector accounts for 58% of total national electricity consumption. The paper proposes a new Comprehensive Contribution to Sustainable Development Index (CCSDI) to assess the contributions of implementation of the LEED 2009 prerequisites and credits in the Energy and Atmosphere (EA) category to achieve UN SDGs in Jordan. Questionnaire surveys were conducted to obtain data, and the Relative Importance Index (RII) method was used to evaluate the contributions of LEED 2009 prerequisites and credits in the EA category. Results indicate a positive relationship between the LEED 2009 prerequisites and credits in category and UN SDGs 7–9 and 12–13. The present study analyses architect questionnaire responses in Pune on green-building practices, beliefs about contribution to urban sustainability, and regulatory or financial barriers.

Bashir et al. (2025) present a critical review of indoor air quality monitoring and solutions within green buildings, examining how green buildings and energy optimization solutions improve indoor air quality (IAQ), indoor environmental quality (IEQ), and human health. The abstract reports that a systematic analysis of 128 peer reviewed publications was conducted, covering design and materials, IAQ monitoring technologies, and health impacts. Technologies such as low cost sensors including Dylos, Foobot, and AirVisual Pro, as well as communication systems like Wi Fi, LoRa, Bluetooth, and VLC, are assessed based on their performance, limitations, and practical use in real time IAQ

monitoring. Key challenges include sensor drift, maintenance demands, environmental sensitivity, and regulatory barriers in specific regions. The abstract further notes that while green buildings generally offer better IAQ, effectiveness varies due to outdoor pollution, building age, and material selection. This published review cannot be read as a result from the present study, which analyses architect questionnaire responses in Pune on green building practices, beliefs about contribution to urban sustainability, and regulatory or financial barriers.

Debrah et al. (2025) review the global outlook on post-occupancy evaluation of green building. The authors note that post-occupancy evaluation (POE) is increasingly important for assessing and understanding the actual performance of green buildings (GBs), yet little effort has been made to provide a systematic and scientometric analysis of the POE-in-GB field. Their study reviews the field and identifies major trends and gaps for future research. The quantitative-bibliometric analysis revealed that POE-in-GB research hotspots include energy efficiency, occupant satisfaction, thermal comfort, IEQ, LEED, and sustainability. The qualitative-systematic analysis focused on the physical environment quality and load, behavioural environment and the POE protocols of POE-in-GB. Proposed future research directions include exploring socio-psychological factors in POE-in-GB, developing standardized protocols for POE-in-GB, aligning GB certifications with user satisfaction, and integrating technology and big data into POE-in-GB. The present study analyses architect questionnaire responses in Pune on green-building practices, beliefs about contribution to urban sustainability, and regulatory or financial barriers, and thus addresses design intent and certification rather than operational performance.

Freitas and Zhang (2018) compare green building rating systems in the Swedish market, specifically LEED, BREEAM SE, GreenBuilding and Miljöbyggnad. The study analyzes each of the four most commonly used systems in Sweden under the aspects of certification process, implementation cost, educational needs and the variety of categories. The SWOT method is further applied to extract the strengths, weaknesses, opportunities and threats of each rating system in a direct and indirect manner. This approach makes it clearer to choose among various options when considering the individual needs of each project in practice. For the present study, which analyses architect questionnaire responses in Pune on green-building practices, beliefs about contribution to urban sustainability, and regulatory or financial barriers, this comparative focus on certification processes and implementation costs underscores a boundary between design intent or certification and operational performance, since the present study does not measure building energy or city outcomes.

Gökce et al. (2026) assess green building certification systems in the city of Izmir. The study examines the sustainability performance of LEED and BREEAM-certified green buildings in Izmir, province of Türkiye, in terms of certification levels, assessment categories, building types and the environmental strategies implemented. The research aims to provide a comparative assessment at a local scale, guided by a conceptual framework based on sustainability, sustainability in architecture, urban sustainability, the green building approach and international certification systems. The findings show 32 LEED-certified projects in Izmir and four BREEAM certification records associated with three separate buildings or projects. Performance in LEED-certified buildings is concentrated in energy and atmosphere, water efficiency, indoor environmental quality, location and transport, and sustainable sites, while materials and resources is under-represented. BREEAM projects are characterised by operational performance of existing buildings, environmental management, energy and water conservation, waste control, user comfort and safety measures. Sustainability priorities vary according to building function. The present study analyses architect questionnaire responses in Pune on green-building practices, beliefs about contribution to urban sustainability, and regulatory or financial barriers, and cannot treat this source as a result from that questionnaire.

Halicioglu and Gurel (2023) examine the perceived quality of green buildings, moving from a review of occupant satisfaction towards a conceptual framework. The authors note that most emphasis in the green building literature on green performance has been on optimizing energy and resource efficiency, a concern often treated as a technical challenge with a premise role in green building projects. They argue that green buildings also need to meet the health, well-being and comfort requirements of occupants and their environmental quality targets, and that perceived quality is a crucial determinant of occupant satisfaction. The study reviews previous research supplemented by an exploratory study of case studies evaluating occupant satisfaction in green buildings, then proposes a conceptual framework linking perceived quality and green building features towards occupant satisfaction. A review of case studies in 49 research articles revealed deficiencies in a comprehensive understanding of perceived quality. The present study, by contrast, analyses architect questionnaire responses in Pune on green-building practices, beliefs about contribution to urban sustainability, and regulatory or financial barriers.

Holmgren et al. (2017) examined occupant perception of "green" buildings, distinguishing physical and psychological factors. The abstract notes that studies have found a preference bias for "environmentally friendly" or "green" artifacts and

buildings, such that indoor environments are more favorably viewed when labeled or certified "green" than when not, even when the two environments are identical. The study explored how physical properties of the indoor environment (high versus low temperature) and labeling ("green" versus "conventional") interact in their effect on environment perception. Participants performed tasks in four indoor environments with different labels (low versus high carbon footprint) and different temperatures (23 °C versus 28 °C), manipulated orthogonally, and participants' environmental concern was measured. Environmentally concerned participants assigned higher thermal acceptance and satisfaction scores to the environment labeled "low carbon footprint" compared to the environment labeled "high carbon footprint," but only in the cooler thermal environment. Environmentally indifferent participants' perception did not differ by label or room temperature. The present study analyses architect questionnaire responses in Pune on green-building practices, beliefs about contribution to urban sustainability, and regulatory or financial barriers, and does not measure building energy or city outcomes.

Khoo et al. (2022) describe a post-occupancy evaluation study on self-reported green behaviors in Hong Kong's public housing estates. The authors note that a green building is believed to promote green behaviors from energy-saving to waste recycling, and that green building certifications have attracted wide interest, with some made mandatory for publicly funded developments in cities such as Hong Kong. Policymakers debate whether the city's expanding public housing stock should be exempted from the green certification mandate for reasons of cost, while evidence of behavioral benefits in green residential buildings is thin, or non-existent for public housing estates. The study subjects are 400 occupants from two pairs of public rental housing estates with or without green certifications. The results show that green-certified housing estates partially induced energy-saving behaviors, but not water saving or waste recycling, nor does it enhance satisfaction or green awareness. The present study analyses architect questionnaire responses in Pune and does not treat these occupant-behaviour findings as a measured city outcome.

Larasati et al. (2023) evaluate the performance of Indoor Environmental Quality (IEQ) and occupant satisfaction in a green building case study at Company X in East Jakarta, DKI Jakarta. The abstract notes that the global movement in green building development has been ongoing since the early 1960s and that, although initially driven by environmental agendas such as carbon and energy, there is growing acknowledgment that green buildings can affect IEQ. Many researchers also state that improved indoor environmental quality is associated with better occupant satisfaction. However, some localized green buildings, especially in developing countries, often do not recognize IEQs and occupant satisfaction as important issues, so they remain unstudied. Using descriptive statistics and regression analysis, the outcome demonstrated that green building standards do not automatically improve indoor environment quality, particularly when the lighting parameter is below the limit values. The analysis findings showed that most respondents expressed satisfaction with IEQ and that it significantly influenced occupant satisfaction. The present study analyses architect questionnaire responses in Pune on green-building practices, beliefs about contribution to urban sustainability, and regulatory or financial barriers.

Li et al. (2022) examine the post-occupancy dilemma in green-rated buildings through a performance gap analysis. The authors note that green-certified buildings, with LEED, BREEAM, DGNB, or other certifications during the design stage, have great potential for increasing the effective use of resources and energy and reducing pollution, and their number has increased greatly in recent years. Post-occupancy evaluation involves assessing whether green buildings meet expected performance during the in-use phase and comprises four steps: carrying out the research purpose or goal, determining the research objectives, conducting data collection, analysis, and visualization, and obtaining the results and drawing conclusions. The authors report that 74%, 12%, and 14% of the projects perform better, similar, and worse, respectively, than their non-green counterparts. The present study analyses architect questionnaire responses in Pune on green-building practices, beliefs about contribution to urban sustainability, and regulatory or financial barriers, and does not measure building energy or city outcomes, so it keeps a boundary between design intent or certification and operational performance.

Mirzaei et al. (2020) conducted a systematic review of the impact of indoor environmental quality of green buildings on occupants' health and satisfaction. The abstract states that the main benefits of green buildings for energy and water conservation have been investigated and well recognized, but that indoor environmental quality and human health benefits have not been examined comprehensively. A systematic search was conducted throughout Science Direct, Google Scholar, and Springer. The authors reviewed 690 articles that examined the relationship between buildings and health, and 40 papers were included in the final analysis. Articles that evaluated indoor environmental quality factors and occupants' health through surveys from 2005 to 2018 were selected. The most important result was identification of important factors in indoor environmental quality, including building design, aesthetics, and ergonomics, which have been less evaluated in previous research. According to this systematic

review, the authors state that they cannot claim that occupants of green buildings enjoy higher indoor environmental quality, satisfaction, or health compared with occupants of non-green buildings. This published evidence cannot be read as a result from the present study, which analyses architect questionnaire responses in Pune.

Rostami (2025) reviews green building certification systems through the lens of sustainable architecture. The abstract states that the building sector, with its investments, consumes 30-40% of the world's primary resources and is continuing to grow, and that energy saving through energy efficiency in buildings has become essential globally. The construction industry has thus become a crucial element not only economically but also in terms of its significant environmental impacts. The study was conducted using a descriptive and analytical method, relying on quantitative data and library research. It examined the principles of sustainable buildings and reviewed rating systems such as BREEAM, CASBEE, GBTool, U.S. Green Globes, and LEED. It was found that the LEED rating system enjoys broader global acceptance, yet each rating system reflects the policies and approaches of different countries regarding sustainability, so the green building topic is a global issue requiring regional solutions. For the present study, this comparison of certification systems is background reading and is not evidence from the Pune questionnaire.

Saidin et al. (2020) present research identifying performance criteria and parameters of Post Occupancy Evaluation (POE) for green building in Malaysia. A green building focuses on increasing the efficiency of resources in term of energy, water and materials, while at the same time reducing the building impact on human health and the environment during the building's lifecycle. Green buildings are significant in operational savings and are able to increase workplace productivity. There are 909 registered green buildings project up to September 2019 in Malaysia. However, previous research indicated the success of green building in term of its performance is still in doubt and very much speculative. Fifteen (15) performance criteria and thirty-five (35) parameters were identified from the literature and validated by green building experts by using Content Validity Index. The finding identifies eleven (11) performance criteria and twenty-six (26) performance criteria to measure the green building performance through POE. The present study analyses architect questionnaire responses in Pune on green-building practices, beliefs about contribution to urban sustainability, and regulatory or financial barriers.

Țîțu et al. (2025) present a comparative analysis of two of the most influential green certification systems worldwide, LEED and BREEAM. In the context of growing concerns over environmental degradation and excessive resource consumption, the construction sector plays a crucial role in promoting sustainability. The article reports that LEED emphasizes energy performance and resource efficiency, while BREEAM offers a comprehensive assessment based on the entire life cycle of the building. The study highlights methodological differences, strengths, and limitations of each system, as well as emerging trends in sustainable certification, such as digitalization, climate neutrality, and adaptability to environmental change. The conclusions underscore the need for an integrated approach that combines the strengths of both frameworks to support the development of sustainable and efficient buildings. The present study analyses architect questionnaire responses in Pune on green-building practices, beliefs about contribution to urban sustainability, and regulatory or financial barriers.

Toğan and Thomollari (2020) examine credit success rates of certified green buildings in Turkey. The authors note that green building rating systems have been used as a tool to evaluate the environmental impact of buildings since 1990. In Turkey, LEED is in the first place concerning the total number of certified green buildings and then followed by BREEAM and DBGN. The paper aims to give general information concerning the 287 certified green buildings, and further investigate an updated situation of credit success rates of 127 LEED new construction certified green buildings in Turkey. The results of the study show that the certified green buildings in Turkey have a lower average percentage of credit success rates in indoor environmental quality, energy efficiency and material and resources categories compared with the other groups. The present study analyses architect questionnaire responses in Pune on green-building practices, beliefs about contribution to urban sustainability, and regulatory or financial barriers, and it does not measure building energy or city outcomes, so it maintains a boundary between design intent or certification and operational performance.

Wang and Zheng (2020) address the integrated analysis of energy, indoor environment, and occupant satisfaction in green buildings. The authors propose a comprehensive quantitative study based on energy-environment-satisfaction and take a three-star green building in Shanghai as an example. Using real-time monitoring data, the study analyses the distribution characteristics of the parameters of energy-environment-satisfaction. It discusses differences between operational energy consumption and design parameters and quantifies the exponential relationship between per floor personnel density and building energy consumption. Combined with the user satisfaction survey, improvements are suggested. The relationship between daily energy consumption and environmental parameters is fitted, indicating a multivariate linear relationship with a correlation of 0.876. Sensitivity analysis found that relative

humidity affects 1.4 times as much as CO2. The present study instead analyses architect questionnaire responses in Pune on green-building practices, beliefs about contribution to urban sustainability, and regulatory or financial barriers.

Wu et al. (2017) investigate the credit achievement pattern of LEED 2009, one of the well-developed versions of the Leadership in Energy and Environmental Design rating system, using 4021 certified projects in the US, China, Turkey, and Brazil. The authors note that more than 20% of the projects are certified in non-US countries and that understanding LEED's performance at the country level is important for developers and regulatory authorities. Their results show significant differences on most rating categories, including sustainable sites, water efficiency, energy and atmosphere, indoor environmental quality, and innovation in design. A post hoc analysis identifies country-specific credit allocation patterns, and the study also finds unbalanced achievement of regional priority credits. The present study, by contrast, examines architect questionnaire responses in Pune concerning green-building practices, beliefs about contribution to urban sustainability, and regulatory or financial barriers.

3. Research Objectives and Hypotheses

The objectives concern associations and mean agreement in the supplied responses. H1 evaluates a positive association using separate predictor and outcome items. H2 evaluates mean agreement against the neutral benchmark of 3. The hypotheses address the full supplied sample and do not compare independent firm categories. No preregistration information accompanies the dataset.

Objectives

Objective 1: To examine the relationship between reported green practices and perceived contribution to urban sustainability.

Objective 2: To determine whether mean regulatory and financial barrier agreement exceeds the neutral score of 3.

Hypotheses

H1o: The population Pearson correlation between green-practice responses and perceived urban-sustainability contribution is zero or negative (rho <= 0).

H1a: The population Pearson correlation between these measures is positive (rho > 0).

H2o: The population mean barrier index is no greater than the neutral value of 3 (mu <= 3).

H2a: The population mean barrier index exceeds 3 (mu > 3).

4. Research Methodology

The primary analytical input is pune_green_urban_sustainability_survey_n178.csv, containing 178 uniquely identified records with age group, years of experience, firm size and ten questionnaire responses. The analysis concerns architect responses in Pune. The file itself does not document recruitment, response rate, collection dates, eligibility verification or ethics approval. These procedures are therefore not asserted. The unit used in the calculations is one CSV row, with respondent independence required for population inference.

Every response is coded from 1, strongly disagree, to 5, strongly agree, with 3 denoting neither agree nor disagree. All ten item values are present and fall within this range. No rows are deleted, duplicated or generated. The original identifiers and categorical labels are retained. Frequencies, percentages, valid percentages and cumulative percentages are calculated for each statement; because item missingness is zero, percentage and valid percentage coincide. Standard deviations use the sample denominator n minus one.

The mean of Q1 to Q4 is the green-practice index. These questions mix reported implementation, design intent and a material-impact belief. Q5 is the separate belief about green buildings' future contribution to Pune's urban sustainability. The mean of Q6 to Q10 is the barrier index, and higher scores indicate greater perceived difficulty. Barrier responses are not reversed. Each arithmetic mean gives equal weight to its included questions. The outcome is excluded from the predictor so that the correlation is not inflated by reusing the same item in both variables. These are descriptive indices rather than validated latent constructs.

H1 uses Pearson product-moment correlation, with a directional alternative of a positive relationship. The correlation treats the arithmetic index and the separate Likert outcome as approximately numeric measures. This is an analytical convention, and an individual ordinal item does not establish equal psychological distances between response categories. H2 uses a one-sample t test of the Q6 to Q10 mean index against 3, the scale's neutral midpoint, with the directional alternative of a mean greater than 3. Both tests report one-sided significance values and use alpha = 0.05 separately for each hypothesis. No family-wide error control is claimed. No reliability coefficients or additional inferential procedures are calculated.

Pearson inference assumes independently sampled observations and an adequate linear association for its interpretation; the exact conventional null significance calculation relies on distributional assumptions. The one-sample t statistic is the observed mean difference divided by its standard error, with n minus one degrees of freedom. The large number of rows supports an approximate sampling-distribution argument for the mean if records are independent, but it cannot establish that independence. The H2 table reports a two-sided 95% confidence interval for the mean difference as an uncertainty summary; this interval is distinct from the one-sided decision rule.

5. Data Analysis and Interpretation

Tables 1 to 3 describe the recorded demographic categories. Tables 4 to 13 each report one questionnaire statement and its own interpretation. Tables 14 and 15 address H1 and H2 respectively. The calculations describe all supplied records. Inferential conclusions remain conditional on authentic independent observations and do not demonstrate causality, representativeness or measured environmental performance.

Table 1. Age Group

Valid category	Frequency	Percent	Valid Percent	Cumulative Percent
25-34	37	20.8	20.8	20.8
35-44	69	38.8	38.8	59.6
45-54	48	27.0	27.0	86.5
55+	24	13.5	13.5	100.0
Total	178	100.0	100.0	

The age distribution of the 178 architects shows that the 35-44 group is the largest, with 69 respondents (38.8%). The 45-54 group follows with 48 (27.0%), then 25-34 with 37 (20.8%), and 55+ with 24 (13.5%). These four categories sum to 178, so every case is classified. The composition is concentrated in the middle two brackets, which together account for 117 architects (65.7%). This table describes only the supplied records and does not establish the age composition of all Pune architects. No inference about how age relates to green practice responses is made here, because the table is purely descriptive. The middle two brackets contribute most of the responses to the pooled questionnaire findings. This composition is relevant when describing whose views appear in the dataset, but the age counts cannot explain agreement with any particular sustainability statement.

Table 2. Experience Years

Valid category	Frequency	Percent	Valid Percent	Cumulative Percent
1-5	19	10.7	10.7	10.7
6-10	47	26.4	26.4	37.1
11-15	61	34.3	34.3	71.3
16-20	31	17.4	17.4	88.8
21+	20	11.2	11.2	100.0
Total	178	100.0	100.0	

Among the 178 architects, the 11-15 year experience band is the most common, with 61 respondents (34.3%). The 6-10 year band contains 47 (26.4%), the 16-20 band 31 (17.4%), the 21+ band 20 (11.2%), and the 1-5 band 19 (10.7%). The cumulative pattern shows that 112 architects (62.9%) have 11 years or more of experience, while 66 (37.1%) have 10 years or fewer. This table reports the distribution of the supplied records only. It does not demonstrate that the sample mirrors the experience profile of Pune architects generally, and no claim is made that experience level influences any other response. The senior categories remain a minority even though records with more than ten years of experience form the majority. This profile locates the pooled responses across different experience bands without explaining their sustainability judgments.

Table 3. Firm Size

Valid category	Frequency	Percent	Valid Percent	Cumulative Percent
Large	50	28.1	28.1	28.1
Medium	73	41.0	41.0	69.1

Valid category	Frequency	Percent	Valid Percent	Cumulative Percent
Small	55	30.9	30.9	100.0
Total	178	100.0	100.0	

Firm size is distributed across three categories: medium firms are the most frequent with 73 respondents (41.0%), followed by small firms with 55 (30.9%) and large firms with 50 (28.1%). The three categories sum to 178. The largest and smallest categories differ by only 23 respondents (12.9 percentage points), so the sample is relatively balanced across firm sizes. This table describes the composition of the supplied records and does not establish the firm-size distribution of the wider Pune architect population. No inference is drawn about how firm size affects green building responses, and the table provides no evidence on that question. Firm sizes are categorical labels here, with no employee or turnover thresholds documented. The distribution therefore describes the labels recorded for respondents rather than establishing equivalent organizational capacities within each category.

Table 4. Q1: Local green building codes are strictly integrated into all our projects.

Valid response	Frequency	Percent	Valid Percent	Cumulative Percent
1 Strongly disagree	6	3.4	3.4	3.4
2 Disagree	33	18.5	18.5	21.9
3 Neither agree nor disagree	45	25.3	25.3	47.2
4 Agree	66	37.1	37.1	84.3
5 Strongly agree	28	15.7	15.7	100.0
Total	178	100.0	100.0	

Agreement or strong agreement accounts for 94 responses (52.8%), neutrality for 45 (25.3%), and disagreement or strong disagreement for 39 (21.9%). The mean is 3.433, with a sample standard deviation of 1.067. A majority endorses strict integration of local green codes, but the substantial neutral and negative groups qualify any claim of consistent integration across all projects. The words strictly and all set a demanding standard: agreement refers to uniform compliance as respondents understand it, not occasional incorporation of selected provisions. Neutrality leaves that uniformity uncertain for a quarter of the sample. The table thus identifies a favorable balance in reported code integration while showing that full endorsement is incomplete. It does not distinguish mandatory requirements from voluntary measures, nor does it record approval or compliance checks. Those distinctions would be necessary to connect the reported practice to demonstrable regulatory implementation.

Table 5. Q2: Our building designs actively aim to reduce the urban heat island effect.

Valid response	Frequency	Percent	Valid Percent	Cumulative Percent
1 Strongly disagree	9	5.1	5.1	5.1
2 Disagree	31	17.4	17.4	22.5
3 Neither agree nor disagree	48	27.0	27.0	49.4
4 Agree	54	30.3	30.3	79.8
5 Strongly agree	36	20.2	20.2	100.0
Total	178	100.0	100.0	

Agreement or strong agreement accounts for 90 responses (50.6%), neutrality for 48 (27.0%), and disagreement or strong disagreement for 40 (22.5%). The mean is 3.433, with a sample standard deviation of 1.144. The positive side forms only a narrow majority, with more than a quarter remaining neutral. The statement concerns a design aim, so endorsement represents reported attention to heat mitigation rather than proof that surrounding temperatures fall. The distinction is particularly relevant at an urban scale, where a project's intention and its

contribution to a wider thermal environment are different questions. The responses show that the aim is recognized by many architects in this sample but cannot be assumed across all records. A useful interpretation is uneven endorsement of heat mitigation as a design objective. Identifying the measures proposed and their assessed thermal effects would be necessary before assigning an actual urban heat benefit.

Table 6. Q3: Decentralized water recycling systems are a standard inclusion in our work.

Valid response	Frequency	Percent	Valid Percent	Cumulative Percent
1 Strongly disagree	13	7.3	7.3	7.3
2 Disagree	24	13.5	13.5	20.8
3 Neither agree nor disagree	47	26.4	26.4	47.2
4 Agree	59	33.1	33.1	80.3
5 Strongly agree	35	19.7	19.7	100.0
Total	178	100.0	100.0	

Agreement or strong agreement accounts for 94 responses (52.8%), neutrality for 47 (26.4%), and disagreement or strong disagreement for 37 (20.8%). The mean is 3.444, with a sample standard deviation of 1.164. Reported standard inclusion receives majority support, yet nearly half of respondents remain neutral or disagree. The phrase standard inclusion refers to a regular feature of practice and should not be reduced to general approval of water recycling. Agreement indicates that respondents describe recycling systems as routine, while the other responses leave such routine use unsupported for a substantial group. The table does not specify system capacity, treatment quality, maintenance arrangements or water reuse quantities. These omissions limit the link between design inclusion and resource savings. The architectural interpretation is that decentralized recycling has a reported place in many practices represented here, with incomplete endorsement of its status as a standard project component.

Table 7. Q4: Sourcing sustainable materials is critical to lowering our projects' carbon footprint.

Valid response	Frequency	Percent	Valid Percent	Cumulative Percent
1 Strongly disagree	10	5.6	5.6	5.6
2 Disagree	27	15.2	15.2	20.8
3 Neither agree nor disagree	46	25.8	25.8	46.6
4 Agree	53	29.8	29.8	76.4
5 Strongly agree	42	23.6	23.6	100.0
Total	178	100.0	100.0	

Agreement or strong agreement accounts for 95 responses (53.4%), neutrality for 46 (25.8%), and disagreement or strong disagreement for 37 (20.8%). The mean is 3.506, with a sample standard deviation of 1.170. This item has the highest mean among Q1-Q4, but it asks about the importance of material sourcing rather than reporting an installed measure. The positive balance therefore indicates belief in a route to carbon reduction, not the amount of sustainable material purchased or a calculated change in emissions. The sizeable neutral group also prevents the belief from being described as universal. Sustainable sourcing could require several different decisions, and the questionnaire does not identify which ones respondents have in mind. Within the H1 predictor, this item consequently adds a belief component to the more practice-oriented questions. That mixed content matters when interpreting the predictor as reported green-practice orientation rather than a direct implementation inventory.

Table 8. Q5: Green buildings are the primary driver for Pune's future urban sustainability.

Valid response	Frequency	Percent	Valid Percent	Cumulative Percent

Valid response	Frequency	Percent	Valid Percent	Cumulative Percent
1 Strongly disagree	2	1.1	1.1	1.1
2 Disagree	27	15.2	15.2	16.3
3 Neither agree nor disagree	74	41.6	41.6	57.9
4 Agree	54	30.3	30.3	88.2
5 Strongly agree	21	11.8	11.8	100.0
Total	178	100.0	100.0	

Agreement or strong agreement accounts for 75 responses (42.1%), neutrality for 74 (41.6%), and disagreement or strong disagreement for 29 (16.3%). The mean is 3.365, with a sample standard deviation of 0.918. Neutrality is the largest single category and is almost as large as the two positive categories combined. The proposition that green buildings are the primary driver is stronger than saying that they contribute to urban sustainability. Respondents may therefore hesitate over the claimed primacy without rejecting green buildings altogether; their reasons are not supplied. The comparatively small negative group and large middle group indicate qualified endorsement rather than broad rejection. This item is the separate H1 outcome, so its interpretation concerns professional belief in a future city-level role. It cannot establish green buildings' actual share of urban improvements or rank their contribution against transport, infrastructure or other urban interventions.

Table 9. Q6: Navigating municipal green building regulations in Pune is highly difficult.

Valid response	Frequency	Percent	Valid Percent	Cumulative Percent
1 Strongly disagree	18	10.1	10.1	10.1
2 Disagree	27	15.2	15.2	25.3
3 Neither agree nor disagree	52	29.2	29.2	54.5
4 Agree	50	28.1	28.1	82.6
5 Strongly agree	31	17.4	17.4	100.0
Total	178	100.0	100.0	

Agreement or strong agreement accounts for 81 responses (45.5%), neutrality for 52 (29.2%), and disagreement or strong disagreement for 45 (25.3%). The mean is 3.275, with a sample standard deviation of 1.211. Reported difficulty is more common than reported disagreement, but it is not endorsed by a majority. The neutral group is also substantial, so the table shows a mixed experience or assessment of regulatory navigation rather than a uniformly adverse response. The item concerns navigating regulations, which is distinct from opposing environmental standards themselves. Agreement may identify a perceived procedural obstacle, but the questionnaire does not record processing times, rejected applications or the provisions involved. This distinction helps keep the interpretation focused on the stated concern. The responses support closer examination of how regulatory procedures are experienced, while neither the severity of individual administrative failures nor their effect on construction outcomes can be quantified here.

Table 10. Q7: The upfront cost of obtaining green certifications (e.g., IGBC/GRIHA) is a major deterrent.

Valid response	Frequency	Percent	Valid Percent	Cumulative Percent
1 Strongly disagree	23	12.9	12.9	12.9
2 Disagree	21	11.8	11.8	24.7
3 Neither agree nor disagree	50	28.1	28.1	52.8
4 Agree	55	30.9	30.9	83.7

Valid response	Frequency	Percent	Valid Percent	Cumulative Percent
5 Strongly agree	29	16.3	16.3	100.0
Total	178	100.0	100.0	

Agreement or strong agreement accounts for 84 responses (47.2%), neutrality for 50 (28.1%), and disagreement or strong disagreement for 44 (24.7%). The mean is 3.258, with a sample standard deviation of 1.240. The positive side is the largest combined group, yet more than half of respondents are neutral or disagree. The relatively wide spread of scores indicates variation in endorsement of the deterrence claim. Certification cost is the specific object of the statement, and the results should not be generalized to all capital costs of green construction. Nor do the ratings show whether respondents abandoned certification, changed project budgets or recovered expenditure through other benefits. The table identifies a substantial group that perceives upfront certification costs as a major obstacle, alongside meaningful contrary and undecided responses. Financial documentation and actual certification decisions would be needed to assess the extent to which this perception corresponds to an observed constraint.

Table 11. Q8: Local zoning laws frequently clash with our sustainable design ambitions.

Valid response	Frequency	Percent	Valid Percent	Cumulative Percent
1 Strongly disagree	12	6.7	6.7	6.7
2 Disagree	31	17.4	17.4	24.2
3 Neither agree nor disagree	58	32.6	32.6	56.7
4 Agree	47	26.4	26.4	83.1
5 Strongly agree	30	16.9	16.9	100.0
Total	178	100.0	100.0	

Agreement or strong agreement accounts for 77 responses (43.3%), neutrality for 58 (32.6%), and disagreement or strong disagreement for 43 (24.2%). The mean is 3.292, with a sample standard deviation of 1.142. The large neutral category is particularly important because the question asserts frequent clashes between zoning and sustainable design ambitions. Many respondents do not clearly endorse that frequency claim, even though the combined positive side is larger than the negative side. The ratings concern perceived compatibility between rules and intentions, not a documented list of conflicting provisions. They also provide no information on the design ambitions involved or whether a conflict was resolved. The result therefore points to a concern reported by a substantial group without establishing that zoning generally prevents sustainable design. A precise follow-up would distinguish the provision, proposed design response and outcome of each reported conflict before considering changes to the rules.

Table 12. Q9: A severe lack of government financial incentives hinders green construction.

Valid response	Frequency	Percent	Valid Percent	Cumulative Percent
1 Strongly disagree	19	10.7	10.7	10.7
2 Disagree	24	13.5	13.5	24.2
3 Neither agree nor disagree	50	28.1	28.1	52.2
4 Agree	64	36.0	36.0	88.2
5 Strongly agree	21	11.8	11.8	100.0
Total	178	100.0	100.0	

Agreement or strong agreement accounts for 85 responses (47.8%), neutrality for 50 (28.1%), and disagreement

or strong disagreement for 43 (24.2%). The mean is 3.247, with a sample standard deviation of 1.157. Nearly half endorse the stated shortage of incentives, but the neutral and negative categories together are slightly larger. The word severe makes this a judgment about adequacy, while hinders adds a perceived consequence for construction. Neither existing incentive amounts nor changes in project uptake are recorded. Agreement should consequently be understood as dissatisfaction with perceived support, rather than evidence that no incentives exist. This item has the lowest mean within the barrier set, although it attracts the largest combined agreement share among those questions; the distribution of stronger and weaker responses explains why those rankings need not match. The table identifies a financing-policy concern whose actual reach would require scheme-specific and project-specific evidence.

Table 13. Q10: Overall, current policy frameworks act as a barrier rather than an enabler.

Valid response	Frequency	Percent	Valid Percent	Cumulative Percent
1 Strongly disagree	10	5.6	5.6	5.6
2 Disagree	36	20.2	20.2	25.8
3 Neither agree nor disagree	52	29.2	29.2	55.1
4 Agree	49	27.5	27.5	82.6
5 Strongly agree	31	17.4	17.4	100.0
Total	178	100.0	100.0	

Agreement or strong agreement accounts for 80 responses (44.9%), neutrality for 52 (29.2%), and disagreement or strong disagreement for 46 (25.8%). The mean is 3.309, with a sample standard deviation of 1.145. The overall policy statement attracts a larger positive group than a negative group, but a majority does not endorse the barrier claim. Its broad wording combines many possible policy experiences, making it less specific than the questions on regulatory navigation, certification cost, zoning and incentives. Neutral answers leave the direction of that general assessment unresolved for a substantial portion of respondents. The mean is the highest within the barrier set, yet it remains relatively close to the neutral midpoint. The result is therefore a qualified negative assessment of policy support within these records. It cannot identify a particular framework responsible for the assessment or establish that changing any one policy would improve green construction.

Table 14. H1 Correlations

Variable	Statistic	Green practices	Urban contribution belief
Green practices	Pearson Correlation	1	0.512
	Sig. (1-tailed)		<0.001
	N	178	178
Urban contribution belief	Pearson Correlation	0.512	1
	Sig. (1-tailed)	<0.001	
	N	178	178

The Pearson correlation between the mean of Q1 to Q4 (green practices) and Q5 (urban contribution belief) is r = 0.512, with a one-sided $p < 0.001$ and N = 178. The predictor mean is 3.454 (SD = 0.508) and the outcome mean is 3.365 (SD = 0.918). At alpha = 0.05, the null hypothesis of no positive association is rejected, and the directional alternative is supported by the supplied responses. Respondents with stronger green-practice responses also tend to report greater agreement with the urban-contribution belief item. This is a pooled association and does not establish an effect of adoption or any measured environmental improvement. It also does not estimate differences between firm categories. The correlation is moderate in size, so the statistical evidence for a positive association is clear, but the practical magnitude is not so large that the two constructs can be treated as interchangeable.

Table 15. H2 One-Sample Test

Measure	t	df	Sig. (1-tailed)	Mean Difference	95% CI Lower	95% CI Upper
Barriers	4.195	177	<0.001	0.276	0.146	0.406

Test value = 3. One-sample statistics: N = 178, mean = 3.276, standard deviation = 0.879, and standard error of the mean = 0.066. The confidence limits are two-sided 95% bounds for the mean difference, not bounds for the mean itself.

The mean of Q6 to Q10 (barriers) is 3.276 (SD = 0.879), which exceeds the neutral test value of 3 by 0.276 scale points. The one-sample t test gives t(177) = 4.195 with a one-sided $p < 0.001$. The two-sided 95% confidence interval for the mean difference runs from 0.146 to 0.406. At alpha = 0.05, the null hypothesis that the barrier mean is no greater than 3 is rejected, supporting above-neutral average perceived regulatory and financial barriers. Because higher scores mean greater barriers, this is evidence of reported difficulty rather than favourable policy conditions. The test compares the full-sample index with the neutral benchmark and makes no comparison between firm categories. Both confidence bounds lie above zero, reinforcing the directional conclusion under the test assumptions. The estimated difference remains small in scale points, so statistical evidence of above-neutral agreement should not be confused with a large practical barrier magnitude.

6. Key Findings and Discussion

The analysis of the Pune architect responses provides two main findings. First, the composite index of reported green practices (mean Q1 to Q4) correlates positively with the perceived urban-sustainability contribution belief item (Q5), $r = 0.512$, $p < .001$, one-sided. Second, the composite index of perceived barriers (mean Q6 to Q10) has a mean of 3.276, which is significantly above the neutral value of 3, $t(177) = 4.195$, $p < .001$, one-sided. These results indicate that architects who perceive stronger green-practice responses also tend to perceive greater agreement about urban sustainability, and that barriers are generally acknowledged as above neutral. However, these are perceptual measures, not objective building energy or city outcomes. The study design cannot establish causal direction or physical performance.

The correlation concerns a professional belief about urban contribution, so operational and occupant evidence in the literature addresses different outcomes. Geng et al. (2019) review energy and indoor environmental performance, while Amiri et al. (2019) review energy performance in LEED-rated buildings. Their findings motivate caution about treating favourable questionnaire responses as proof of resource savings. Trindade et al. (2017) and Yigitcanlar et al. (2019) locate sustainability within broader urban and smart-city debates; these concerns help explain why building practices require additional information about coverage and governance before city-wide benefits can be inferred. The barrier mean identifies reported obstacles, but the instrument does not determine which obstacle causes a particular implementation shortfall.

The instrument used here is a set of single-item Likert measures combined into descriptive arithmetic means. These composites are not validated scales. The one-sample t test and Pearson correlation are the only statistical procedures applied, each hypothesis tested separately with a one-sided alpha of 0.05. Exact sampling, collection timing and recruitment procedures for the 178 records are not documented. Therefore, the findings describe this respondent group only and cannot be generalized to all Pune architects or to building performance. No firm size differences, regressions, or mediation analyses are claimed.

The practice-contribution association and above-neutral barrier mean can coexist. Agreement that green buildings matter for Pune does not imply that regulation, certification costs, zoning or incentives are experienced as supportive. The individual statement tables reveal the response distribution for each concern, whereas the arithmetic barrier mean combines different obstacles. These results can inform questions for subsequent project-based investigation, but they do not select an effective policy intervention or quantify its benefits. Figure 2 shows the additional verified indicators and aggregation boundaries needed to evaluate urban outcomes. Such evidence would complement professional perceptions without assuming that a positive correlation establishes a causal contribution to city sustainability.

7. Conclusion

The revised analysis of 178 supplied records reports each questionnaire statement separately and evaluates two method-compatible hypotheses. The positive Pearson correlation of 0.512 links reported green practices with perceived urban-sustainability contribution. The one-sample t test identifies a mean barrier score of 3.276, above the neutral

benchmark of 3. Both directional tests are below the stated alpha of 0.05. These conclusions concern response patterns and are conditional on the assumptions needed for inference.

The paper identifies favourable beliefs about green-building contribution alongside reported implementation barriers, while leaving measured urban benefits for resource accounting and project verification. The supplied file does not establish recruitment, consent, eligibility or independence. Results should therefore be presented as an analysis of supplied data rather than an authenticated population study. The sourced external evidence and conceptual figures provide context without transferring their numerical findings to Pune.

8. Suggestions

Future instruments should distinguish implemented green practices from general sustainability beliefs. Q4 and Q5 contain evaluative language, and additional project-specific implementation indicators would clarify the meaning of the practice-contribution association. Measured water, energy and material outcomes would support environmental evaluation.

The separate barrier statements provide a basis for investigating certification costs, regulations, zoning and incentives. Any proposed support mechanism should be evaluated using documented exposure and outcomes. The above-neutral barrier mean alone cannot establish which policy change will work or quantify its effect.

Building-to-city evaluation should specify geographic coverage, reporting periods and compatible resource denominators before aggregation. Project indicators need verification and safeguards against double counting. Further survey work should document recruitment and respondent independence so that professional perceptions can be compared with appropriately bounded urban evidence.

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