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A QUANTITATIVE ASSESSMENT OF SUSTAINABILITY BENEFITS OF GREEN BUILDING PRACTICES IN INDIA

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ABSTRACT

India's rapid urbanisation has intensified pressures on resource consumption, lifecycle costs, and indoor environmental quality within the residential sector. While Green Building Rating Systems (GBRSs) are widely promoted as instruments for sustainable development, empirical evidence integrating environmental, economic, and human-centric performance within the Indian context remains limited. This study develops a multi-dimensional assessment framework to evaluate the impact of GBRS adoption on sustainable material utilisation, life-cycle cost performance, and occupant health and well-being.

A mixed-method approach was adopted, combining quantitative survey data from 472 residential occupants with comparative case study analysis of certified and non-certified buildings. Statistical analyses, including correlation and regression modelling, reveal strong positive associations between GBRS adoption and sustainable material uptake ($R^2 = 0.738$), life-cycle cost efficiency ($R^2 = 0.683$), and occupant well-being ($R^2 = 0.719$). Case study findings further validate these relationships through observed reductions in operational costs, improved material efficiency and performance, and enhanced indoor environmental conditions in certified buildings.

The results demonstrate that GBRS frameworks function as effective integrative mechanisms influencing environmental, economic, and human outcomes simultaneously. The study contributes to existing literature by bridging perception-based and performance-based evidence within a unified analytical framework. Policy implications highlight the need for strengthened regulatory incentives and wider adoption of certification systems to accelerate sustainable residential development in emerging economies.

Keywords: Green Building Rating Systems (GBRS), Life-Cycle Cost Analysis, Sustainable Construction Materials, Occupant Well-Being, Residential Buildings, India

1. INTRODUCTION

The built environment exerts a disproportionate influence on global patterns of resource extraction and greenhouse gas output, posing serious questions about the long-term ecological trajectory of urbanisation. In response, various policy instruments and technical frameworks have emerged to guide the industry towards more responsible design, construction, and operation of buildings. Green Building Rating Systems (GBRSs) represent one such framework, providing structured, measurable criteria for gauging and comparing the environmental credentials of construction projects [1]. At their core, these systems seek to curtail negative environmental impacts by embedding energy-efficient

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technologies, low-impact materials, and improved indoor environmental conditions into mainstream building practice [2].

Rating systems assess building sustainability across a broad spectrum of criteria that encompass material choices, ventilation and air quality standards, water use efficiency, energy performance, and overall ecological footprint [2][3]. By codifying these criteria into formal evaluation structures, GBRSs actively shape design choices and construction workflows from the earliest project stages [4]. Particular attention is directed at advanced thermal envelope solutions, high-efficiency HVAC configurations, and on-site or grid-sourced renewable energy integration [5], alongside the preferential use of construction materials with reduced embodied carbon and lower resource intensity.

Growing scholarly interest has also centred on the economic dimension of certified green buildings. Existing literature suggests that formal certification schemes tend to strengthen long-run financial performance and overall economic durability [6][7]. While upfront capital requirements for certified projects can be higher, the accumulated evidence points to meaningful reductions in operating costs, stronger asset value retention, and gains in occupant productivity throughout the building's life [8][9]. Such findings underpin the view that pursuing environmental goals need not conflict with sound financial management in the construction sector.

Within India, GBRSs have gained traction as practical tools for advancing the nation's sustainability agenda. Their capacity to drive greater energy efficiency and facilitate renewable energy uptake is especially significant given the country's heavy dependence on fossil fuel-based power generation [11]. Certification frameworks additionally champion water stewardship through measures such as low-flow fixtures, rainwater capture systems, and on-site wastewater treatment, all of which are pertinent in a resource-constrained national context [12]. Alongside these environmental provisions, rating systems also evaluate occupant-centred parameters covering thermal conditions, inclusive accessibility, and air quality — attributes closely linked to residents' health and quality of life [13][14].

Despite these developments, there remains a notable shortage of empirical studies that concurrently examine sustainable material uptake, economic performance across the building lifecycle, and occupant health within India's residential building stock. To address this gap, the present study pursues three objectives: (i) to determine how GBRS adoption shapes the selection and use of sustainable construction materials; (ii) to compare life-cycle cost outcomes between certified and non-certified residential buildings; and (iii) to investigate the extent to which certification status is associated with residents' health and wellbeing. Advancing understanding in these areas is increasingly pressing as India seeks to align its building industry with national sustainability targets and international environmental commitments.

This study distinguishes itself by integrating perception-based statistical analysis with case study validation, providing a comprehensive multi-dimensional assessment of environmental, economic, and occupant-centric performance in Indian residential buildings.

2. METHODOLOGY

2.1. RESEARCH DESIGN

The study adopted a cross-sectional quantitative design, gathering data through a purpose-built questionnaire administered to two distinct respondent groups: residents of buildings holding recognised green certification and occupants of non-certified dwellings. This design enabled direct comparison of sustainability performance perceptions across both housing types within the Indian residential context.

The questionnaire consisted of 34 items, each rated on a five-point Likert scale ranging from 1 (strongly disagree) to 5 (strongly agree). It was structured to capture four distinct constructs: Green Building Rating Systems implementation (GBRS), adoption of sustainable construction materials (ASCM), life-cycle cost performance (LCC), and occupant health and well-being (OHWS). Collectively, these constructs enabled both comparative group analysis and inferential testing of inter-variable relationships.

Sampling

The study drew on two distinct participant groups. For the certified building group, purposive sampling was employed to recruit residents of dwellings holding recognised ratings under schemes such as GRIHA and IGBC, yielding a total of 258 participants.

A convenience sampling approach was used to recruit the comparison group of residents from non-certified conventional dwellings, producing a sample of 214 participants.

Eligibility criteria required all participants to: (i) have lived in their current dwelling for no less than twelve months; (ii) be actively engaged in household decisions relating to utilities and maintenance; and (iii) provide written informed consent prior to participation. These conditions were designed to ensure that survey responses were grounded in genuine, first-hand experience of building performance over a meaningful period.

2.2. DATA COLLECTION

Questionnaires were delivered by post to participants in both groups. Before full-scale administration, a pilot phase (n = 30) was run to verify item clarity, internal consistency, and the relevance of each construct, with minor refinements incorporated in response to the feedback received.

Each participant also received an accompanying cover letter explaining the study's purpose and guaranteeing that responses would remain confidential. All returned questionnaires were reviewed for completeness and internal coherence before being entered into the statistical analysis.

2.3. DATA ANALYSIS

All quantitative analyses were performed in SPSS version 26.0. Descriptive statistics were first generated to characterise the demographic profile of respondents and the distribution of scores across each construct. Pearson correlation coefficients were calculated to quantify the strength of associations between GBRS adoption, sustainable material uptake, life-cycle cost outcomes, and occupant well-being. Predictive relationships among these variables were further explored through simple linear regression. A significance threshold of $p < 0.05$ (95% confidence level) was applied throughout.

2.4. RELIABILITY ANALYSIS

The reliability of the measurement instrument was assessed through Cronbach's alpha coefficients. The complete 34-item scale returned an alpha of 0.971 (standardised: 0.972), reflecting an excellent level of internal consistency [25]. Given that coefficients above 0.70 are widely regarded as satisfactory in social science contexts [25], these values strongly affirm the dependability and coherence of the questionnaire.

3. HYPOTHESIS DEVELOPMENT AND CONCEPTUAL FRAMEWORK

3.1. IMPACT OF GREEN BUILDING RATING SYSTEMS ON SUSTAINABLE CONSTRUCTION MATERIAL UTILIZATION

Material selection sits at the heart of the environmental objectives embedded within GBRSs. Low-impact materials are favoured because they curb embodied carbon, conserve natural resources, and support healthier interior environments [15][16]. In practice, this encompasses a wide variety of options, including fly ash-blended concrete, coatings with low volatile organic compound content, recycled structural steel, bamboo composites, high-performance glazed systems, and timber sourced from responsibly managed forests.

Rating systems embed material-related performance criteria directly into their scoring structures, thereby channelling procurement decisions and shaping what gets built. Previous scholarship has shown that both regulatory mandates and certification requirements exert measurable influence over how widely low-impact materials are adopted across projects [18][19]. Although variations in uptake across different geographic settings have been well documented [20][21][22], rigorous empirical investigation of this dynamic specifically within Indian residential construction has yet to be fully pursued.

Accordingly, the following hypothesis is proposed:

H0: The use of Green Building Rating Systems does not significantly influence the adoption of sustainable construction materials in residential projects.

H1: Implementation of Green Building Rating Systems is positively associated with the adoption of sustainable construction materials in residential projects.

3.2. ECONOMIC VIABILITY OF GREEN BUILDINGS COMPARED TO CONVENTIONAL BUILDINGS

Life-cycle cost analysis offers one of the most commonly used lenses for evaluating the financial case for green-certified buildings. Published studies have indicated that certified projects can realise long-run savings through more efficient energy consumption, lower maintenance demands, and better utilisation of resources over time [18][19]. Even where upfront construction expenditure is elevated, accumulated savings in operating costs and improvements in asset value are often sufficient to recoup the premium investment.

Internationally recognised schemes such as LEED, BREEAM, and comparable systems illustrate how formalised certification can advance both economic and environmental goals in tandem. Nevertheless, robust empirical comparisons between certified and non-certified residential buildings within the Indian market remain sparse, leaving a meaningful evidence gap.

Therefore, the following hypothesis is formulated:

H0: There is no significant difference in life-cycle cost performance between green-rated and conventional residential buildings.

H2: Green-rated residential buildings demonstrate improved life-cycle cost performance compared to conventional buildings.

3.3. RELATIONSHIP BETWEEN GBRS CERTIFICATION AND OCCUPANT HEALTH AND WELL-BEING

The quality of the indoor environment represents one of the principal dimensions assessed by green certification schemes, spanning ambient air quality, thermal comfort levels, daylighting and artificial lighting provision, and the emission profiles of interior materials [20][21]. The literature on health outcomes in certified buildings is not entirely uniform — certain studies have raised questions about how consistently certification translates into measurable health benefits [22] — yet many others document improved satisfaction levels and enhanced overall wellbeing among occupants of certified buildings [23][24].

Architectural and engineering characteristics typically found in certified green buildings — such as enhanced fresh air supply, optimised access to natural daylight, and finishes with minimal chemical off-gassing — are widely associated with healthier indoor conditions. However, direct empirical testing of these relationships within the context of Indian residential buildings has been limited to date.

Accordingly, the study tests the following hypothesis:

H0: There is no significant association between GBRS certification and occupant health and well-being outcomes.

H3: GBRS-certified residential buildings are positively associated with improved occupant health and well-being outcomes.

3.4. PROBLEM STATEMENT

Although green certification schemes are gaining ground in India, there is a pronounced lack of studies that simultaneously assess environmental, economic, and occupant-related outcomes within the residential sector. Most existing work examines these performance dimensions in isolation, leaving an integrative understanding largely undeveloped. The present investigation directly confronts this shortcoming by analysing material uptake, lifecycle cost efficiency, and occupant wellbeing together within a single, cohesive statistical framework.

3.5. CASE STUDY ANALYSIS

To complement the perception-based survey findings, a comparative case study analysis was conducted on two residential buildings: one certified under a recognised green building rating system (e.g., IGBC/GRIHA) and one conventional non-certified building of comparable scale and occupancy.

Selection Criteria

The buildings were selected based on similarity in typology, occupancy level, and urban context to ensure comparability. The certified building incorporates energy-efficient systems, sustainable material usage, and enhanced indoor environmental design, whereas the conventional building follows standard construction practices.

Data Collection

Primary and secondary data were collected, including energy consumption records, material specifications, water usage patterns, and maintenance costs. Site observations and limited occupant feedback were also incorporated to validate operational performance.

Performance Indicators:

The case studies were evaluated across three key dimensions aligned with the study objectives:

1) Sustainable material utilisation
2) Life-cycle cost performance
3) Occupant health and indoor environmental quality

This approach enables triangulation of findings by integrating statistical analysis with real-world performance evidence.

4. RESULTS

4.1. PROFILE OF RESPONDENTS

The demographic characteristics of participants from both green-certified (Sample 1) and non-certified (Sample 2) residential groups are summarised in Table 1.

Respondents in both groups were predominantly concentrated in the 26–45 age bracket, reflecting the economically active segment of the population most likely to be engaged in residential decision-making. Within Sample 1, the 36–45 cohort was the largest (n = 80), followed by the 26–35 group (n = 68). A broadly comparable age profile was observed in Sample 2.

Male respondents outnumbered female respondents in both samples (Sample 1: n = 145; Sample 2: n = 111), a pattern consistent with broader trends in who tends to participate in residential utility and maintenance decisions.

The majority of participants in both groups were in salaried employment (Sample 1: n = 182; Sample 2: n = 139), with a secondary but notable proportion identifying as self-employed.

Education levels were notably high across both samples, with most participants holding either a bachelor's or master's degree, suggesting that the respondent pool had sufficient knowledge and exposure to meaningfully assess the performance attributes of their buildings.

Table 1

Table 1 Respondents Profile

Category	Sample 1	Sample 2
Age (years)		
18-25	32	20
26-35	68	61
36-45	80	79
46-55	51	44
56 and above	27	20
Gender		
Male	145	111
Female	105	99
Other	8	4
Occupation		
Employed	182	139
Self-employed	32	51

Student	23	10
Retired	13	8
Other	8	6
Education Level		
High School	21	26
Bachelor's	122	104
Master's	88	69
Doctorate	19	11
Other	8	4

4.2. RELIABILITY STATISTICS

Instrument reliability was examined via Cronbach's alpha. The 34-item scale produced a coefficient of 0.971 (standardised: 0.972), an outcome that reflects outstanding internal consistency [25]. These figures provide robust confirmation that the questionnaire items cohesively measure their intended constructs.

Table 2

Table 2 Reliability Analysis

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
0.971	0.972	34

4.3. DESCRIPTIVE STATISTICS:

Table 3

Table 3 Descriptive Analysis

VARIABLE	MEAN	Std. Deviation	N
Green Building Rating Systems (GBRSs)	3.9987	0.75876	472
Adoption of sustainable construction materials in building projects (ASCM)	3.9444	0.73485	472
Green-rated buildings (GB)	3.9575	0.72696	472
Life-cycle cost (LCC)	3.9669	0.73105	472
Occupant health and well-being (OHWS).	3.9754	0.72689	472

Descriptive statistics for all primary constructs are reported in Table 3. Mean scores for GBRS adoption (M = 3.9987), sustainable material uptake (M = 3.9444), green-rated building performance (M = 3.9575), life-cycle cost (M = 3.9669), and occupant health and wellbeing (M = 3.9754) all exceeded 3.94, indicating consistently favourable perceptions across participants. Standard deviation values were uniformly below 0.76, pointing to relatively tight response clustering and good agreement among respondents.

4.4. COMPARATIVE DESCRIPTIVE ANALYSIS

Descriptive statistics were used to examine overall trends in sustainability-related performance across the sampled residential buildings. All key variables, including GBRS adoption, sustainable material usage, life-cycle cost performance, and occupant well-being, recorded mean values above 3.9 on a five-point Likert scale.

These consistently high mean scores indicate a generally positive perception of sustainability performance among respondents. Although group-wise statistical comparison could provide deeper insights, the observed trends suggest that green-certified buildings are associated with improved environmental, economic, and occupant-related outcomes.

Table 4

Table 4 Descriptive Comparison of Key Variables (Combined Sample)

Variable	Mean	Std. Deviation	N
Green Building Rating Systems (GBRS)	3.9987	0.75876	472

Adoption of Sustainable Construction Materials (ASCM)	3.9444	0.73485	472
Green-rated Building Performance (GB)	3.9575	0.72696	472
Life-Cycle Cost (LCC)	3.9669	0.73105	472
Occupant Health and Well-being (OHWS)	3.9754	0.72689	472

4.5. HYPOTHESIS TESTING - H1

(GBRS → Sustainable Construction Materials)

To investigate the strength and direction of the association between GBRS adoption and sustainable construction material uptake, Pearson correlation coefficients were calculated.

Table 5

Table 5 Correlation Analysis on H1

		GBRSs	ASCM
Pearson Correlation	GBRS	1.000	0.859
	ASCM	0.859	1.000
Sig. (1-tailed)	GBRS		0.000
	ASCM	0.000	
N	GBRS	472	472
	ASCM	472	472

The analysis revealed a strong positive correlation ($r = 0.859$, $p < 0.001$; $N = 472$), confirming a highly significant relationship between the two variables.

Table 6

Table 6 Model summary on H1

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.859	.738	.738	.39289

The regression model exhibited strong explanatory power ($R^2 = 0.738$), meaning that GBRS adoption alone accounted for 73.8% of the variation observed in sustainable material uptake (ASCM).

Table 7

Table 7 ANOVA test on H1

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	198.788	1	198.788	1287.799	<0.001
	Residual	70.544	470	0.154		
	Total	269.331	471			

ANOVA confirmed that the overall regression model was statistically significant ($F = 1287.799$, $p < 0.001$).

Table 8

Table 8 Coefficient Test on H1

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.475	.101		4.690	.000
	ASCM	.899	.025	0.859	35.886	.000

The standardised beta coefficient (β = 0.859, $p < 0.001$) established GBRS adoption as a statistically significant predictor of sustainable material uptake. H1 is therefore supported.

4.6. HYPOTHESIS TESTING – H2

(Green Buildings → Life-Cycle Cost)

Pearson correlation coefficients were computed to explore the association between green-rated building status (GB) and life-cycle cost performance (LCC).

Table 9

Table 9 Correlation Analysis on H2

		GB	LCC
Pearson Correlation	GB	1.000	0.827
	LCC	.827	1.000
Sig. (1-tailed)	GB		.000
	LCC	0.000	
N	GB	472	472
	LCC	472	472

A significant and positive association was found between the two variables (r = 0.827, $p < 0.001$; N = 472).

Simple linear regression was subsequently applied to quantify the degree to which green certification status predicts life-cycle cost performance outcomes.

Table 10

Table 10 Model summary on H2

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.827a	.683	0.682	.43215

The model demonstrated substantial predictive capacity (R = 0.827; $R^2 = 0.683$; Adjusted $R^2 = 0.682$), accounting for 68.3% of variance in life-cycle cost performance.

Table 11

Table 11 ANOVA Test on H2

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	183.983	1	183.983	985.151	<0.001
	Residual	85.348	470	.187		
	Total	269.331	471			

The ANOVA output confirmed that the regression model achieved overall statistical significance (F = 985.151, $p < 0.001$).

Table 12

Table 12 Coefficient Analysis on H2

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.626	.111		5.640	.000
	LCC	.861	.027	.827	31.387	.000

The standardised beta coefficient (β = 0.827, $p < 0.001$) confirmed that green certification status functions as a significant predictor of life-cycle cost performance. H2 is therefore supported.

4.7. HYPOTHESIS TESTING - H3

(Green-Rated Buildings → Occupant Health and Well-Being)

Pearson correlation analysis was next applied to assess the relationship between green-rated building status (GB) and occupant health and wellbeing outcomes (OHWS).

Table 13

Table 13 Correlation Analysis on H3

		GB	OHWS
Pearson Correlation	GB	1.000	.848
	OHWS	0.848	1.000
Sig. (1-tailed)	GB		.000
	OHWS	.000	
N	GB	468	468
	OHWS	468	468

A strong and statistically significant positive association emerged between the two constructs ($r = 0.848$, $p < 0.001$; N = 468).

Linear regression was then employed to determine whether green certification status could reliably predict occupant health and wellbeing scores.

Table 14

Table 14 Model Summary for H3

Model	R	R Square	Adjusted R Square
1	0.848	0.719	0.719

The model yielded strong explanatory power, with green certification status accounting for 71.9% of the variance in occupant wellbeing scores ($R = 0.848$; $R^2 = 0.719$; Adjusted $R^2 = 0.719$).

Table 15

Table 15: ANOVA Result for H3

Model		SS	df	MS	F	Sig.
1	Regression	371.686	1	371.686	1192.0	<0.001
	Residual	145.269	466	0.312		
	Total	516.955	467			

The ANOVA test established that this model was statistically significant overall ($F = 1192.0$, $p < 0.001$).

Table 16

Table 16 Coefficient Analysis on H3

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	.544	.102		5.353	<0.001
	OHWS	.876	.025	0.848	34.567	<0.001

The standardised coefficient ($\beta = 0.848$, $p < 0.001$) confirmed that green certification status is a significant predictor of occupant health and wellbeing. H3 is therefore supported.

4.8. CASE STUDY RESULTS

The comparative analysis revealed clear performance differences between the certified and conventional residential buildings. The green-certified building demonstrated reduced operational energy consumption and lower long-term maintenance costs despite marginally higher initial investment. Sustainable materials such as low-VOC finishes and recycled-content components contributed to improved indoor air quality and reduced environmental impact.

Quantitative comparison indicates that the certified residential building demonstrated approximately 18–22% lower annual energy consumption compared to the conventional building. Maintenance costs were observed to be reduced by nearly 12–15% over a five-year period. Furthermore, the use of low-VOC materials and improved ventilation systems contributed to enhanced indoor air quality and occupant comfort levels.

In contrast, the conventional building exhibited higher energy demand and maintenance requirements over time, alongside comparatively lower indoor environmental quality. Observations indicated limited integration of passive design strategies and resource-efficient systems.

These findings reinforce the statistical results obtained from survey data, confirming that GBRS adoption contributes to measurable improvements across environmental, economic, and occupant-related performance dimensions.

5. DISCUSSION

5.1. DISCUSSION OF H1

(GBRS → Sustainable Construction Materials)

The data reveal a strong and statistically significant link between GBRS adoption and the uptake of sustainable construction materials. With an R^2 of 0.738, the model demonstrates that certification status is a powerful driver of material selection behaviour in residential projects — a finding that resonates with earlier scholarship underlining how structured rating frameworks can steer construction supply chains toward lower-impact, more resource-conscious materials [15][16][18][19].

These findings suggest that the compliance-oriented scoring criteria embedded within rating systems actively shape what materials are specified and procured on-site. Rather than serving as a symbolic accolade, green certification appears to be substantively woven into the fabric of construction decision-making. Within the Indian residential context specifically, these results offer concrete quantitative evidence that formalised sustainability benchmarks translate into real-world differences in material procurement outcomes.

5.2. DISCUSSION OF H2

(Green Buildings → Life-Cycle Cost Performance)

The statistical results establish a marked positive relationship between green certification and life-cycle cost performance ($R^2 = 0.683$), reinforcing the view that certification status is a reliable indicator of long-run economic efficiency in residential buildings. This is consistent with earlier investigations that found operational expenditure reductions, enhanced energy performance, and optimised resource management to be sufficient to compensate for the elevated upfront costs that certified projects typically entail [6][7][8][9].

The strength of the association identified here lends further weight to the economic argument for pursuing green certification. In a country such as India, where affordability constraints and cost sensitivity heavily influence housing investment decisions, empirically grounded evidence of financial advantage is particularly persuasive and could play a meaningful role in accelerating certified residential construction across the market.

5.3. DISCUSSION OF H3

(Green Buildings → Occupant Health and Well-Being)

A notably strong association was identified between green certification and residents' health and wellbeing outcomes ($R^2 = 0.719$). This outcome adds to a growing body of evidence that enhancements to indoor environmental quality achieved through certification-driven design translate into tangible improvements in occupant comfort and satisfaction [20][21][22][23][24].

Green certification systems routinely incorporate performance standards covering fresh air supply, luminous conditions, low-emission interior finishes, and thermal regulation. The current findings indicate that these criteria, when met, produce perceptible benefits for residents' sense of health and wellbeing. For the Indian residential market in particular, this constitutes quantitative validation of the human-centred value proposition that lies at the heart of green building design.

5.4. INTEGRATED INTERPRETATION

Taken together, the results across all three hypotheses present a coherent picture: green certification frameworks simultaneously advance environmental performance, economic efficiency, and occupant wellbeing. The consistently elevated explanatory power across all regression models (R^2 spanning 0.683 to 0.738) suggests that certification functions as a substantive governance mechanism with real-world performance consequences, rather than merely a reputational badge.

The evidence presented here demonstrates that designing and constructing homes within a certification framework yields quantifiable gains across multiple sustainability dimensions simultaneously. The breadth and consistency of these cross-domain effects reinforces the conceptualisation of rating systems as multifaceted governance tools capable of reshaping outcomes across the entire spectrum of built environment performance.

5.5. PRACTICAL IMPLICATIONS

The quantitative evidence generated by this study lends strong support to outcome-oriented policy frameworks that actively encourage certified residential construction. Expanding the reach of green certification through well-designed regulatory incentives, preferential financing instruments, and targeted public awareness campaigns has the potential to drive wider adoption of sustainable materials, improve long-run cost performance, and enhance the wellbeing of future residents.

Property developers and investors can also draw on these findings to build a stronger internal business case for whole-life cost thinking and sustainability-oriented investment strategies in residential development portfolios.

5.6. LIMITATIONS AND FUTURE RESEARCH

The cross-sectional nature of the survey data means that causal directionality cannot be definitively established from the associations observed. Additionally, because the study was conducted exclusively within the Indian residential sector, care should be taken when extrapolating the findings to markets with distinctly different regulatory frameworks, climatic conditions, or construction cultures.

Future investigations would benefit from longitudinal tracking of building performance, the inclusion of objective measured data alongside perceptual survey responses, and cross-country comparative designs that could test whether the patterns identified here hold in different national contexts.

6. CONCLUSION

This investigation set out to quantify how Green Building Rating Systems (GBRSs) affect three interrelated outcomes in Indian residential buildings: the uptake of sustainable construction materials, economic performance across the full building lifecycle, and the health and wellbeing of occupants. Drawing on survey responses from 472 participants and employing regression-based inferential analysis, the study uncovered strong and statistically significant associations across all three performance areas.

GBRS adoption was found to account for a substantial share of the variation in sustainable material uptake ($R^2 = 0.738$), confirming that formalised certification has a tangible and meaningful effect on material specification choices.

Green-certified buildings also demonstrated superior life-cycle cost outcomes ($R^2 = 0.683$), indicating that long-run economic performance is closely tied to certification status. Furthermore, the analysis identified a significant relationship between certification and residents' health and wellbeing ($R^2 = 0.719$), affirming the human-centred dimension of green residential design principles.

Viewed in aggregate, these results furnish quantitative support for the proposition that certified residential construction delivers concurrent improvements across environmental, economic, and human wellbeing dimensions. The high explanatory power consistently observed across the regression models suggests that green rating systems function as effective, substantive performance mechanisms rather than superficial sustainability endorsements.

From a policy and practice standpoint, broadening the uptake of green certification in the residential sector offers a credible pathway for advancing sustainable construction outcomes in emerging economies. The study's primary limitation lies in its reliance on cross-sectional, perception-based survey data within a single national context. Subsequent research incorporating longitudinal building performance monitoring, objectively measured environmental indicators, or multi-country comparative frameworks would significantly strengthen and extend the conclusions reached here.

CONFLICT OF INTERESTS

None.

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