Research Paper

Critical Success Criteria for sustainable and affordable housing delivery in high-density urban areas

A case study of Indian megacities

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Abstract

Housing is a critical determinant of citizens' quality of life, especially in rapidly urbanizing nations like India. Despite various housing policies, considerable debate remains about which factors are essential for achieving sustainable and affordable housing (SAH) in high-density urban areas. This paper reviews the CSCs of SAH delivery in Indian megacities based on an in-depth analysis of experts' opinions. It was undertaken through a questionnaire survey among 100 housing experts and factor analysis to derivate six significant elements: Housing Operational Cost, Land Use Planning, Housing Quality and Safety, Project Management and Governance, Social and Community aspects, and Environmental Quality and Sustainability. While cost-related criteria maintained primary importance (explaining 17.897% variance), with ranking and normalization analysis identifying the top three CSCs as housing price versus income (mean=4.55), lifecycle cost reduction (mean=4.53), and rental price versus income (mean=4.52), the findings reveal significant correlations between various CSCs, highlighting their interconnected nature. This study contributes to the literature on affordable housing and develops a validated framework for high-density urban environments. This research concludes that SAH needs to be implemented through an integrative holistic approach covering multiple sustainability dimensions, not just economic ones, and offers insight into comprehensive housing strategies.

Keywords

Critical success criteria, Affordable, Sustainable, Housing, India

1. Introduction

Housing is one of the most fundamental human needs, essential for improving the quality of life and providing social cohesion and sustainable development (Saha et al., 2024; Winston and Pareja Eastaway, 2008). However, rapid urbanization has put immense pressure on housing infrastructure, particularly in developing countries where urban population growth is accelerating at unprecedented rates (Roy, 2020). By 2050, an estimated 90% of the additional 2.5 billion urban dwellers will come from developing nations. The burden will be predominantly in Asia as well. According to UN-Habitat (2005), India faces a severe

housing crisis. Around 80% of this crisis is attributed to inadequate and overcrowded living conditions (Abhay and Sharma, 2023; Surjan and Shaw, 2009). Approximately 35% of urban residents live in substandard housing, which could rise to 38% by 2030 if adequate measures are not implemented. Furthermore, only about 8% of the housing supply is affordable and sustainable for middle-class urban residents (Tiwari and Rao, 2011). The situation is even more dire for marginalized communities, low-income groups (LIG), and other disadvantaged sections of society, who account for 96% of India's housing deficit of 18.78 million units (Agarwal et al., 2021). These statistics indicate the need for affordable housing strategies to efficiently address growing needs while promoting equitable and sustainable urban development.

This study explores the challenges of affordable and sustainable housing for densely populated urban areas in Indian megacities. Indeed, though numerous government-sponsored initiatives have been undertaken to reduce housing shortages, the effectiveness of these interventions remains debatable, particularly for LIGs (Chan and Adabre, 2019; Saha et al., 2024). Traditionally, price affordability has been the focal point, while other essential factors like environmental sustainability, accessibility, and social integration have been omitted from consideration (Mulliner et al., 2013). Such a narrow view has resulted in problems such as housing underutilization and abandonment of affordable housing schemes. For instance, Greater Mumbai has more than 15% of its residential stock lying vacant while facing an acute shortage of housing (Gandhi et al., 2022). Similar trends noticed in Indian megacities have strengthened this argument. This paper will enhance the comprehension of SAH provision by scrutinizing economic and non-economic indicators.

The necessity of this research is rooted in addressing several significant challenges and gaps in current research and policy instruments. Despite the overwhelming body of literature, housing sustainability and affordability have been regarded as two distinct areas. The gap observed so far in terms of a lack of integrating frameworks capable of addressing the needs of the densely populated urban regions lies here. The contemporary literature often cannot consider the interplay of complexity between environmental issues, social equity, and economic pressures in fast-growing cities like India's megacities (Adabre and Chan, 2019b; Yan et al., 2019). Moreover, no uniform criteria for evaluating housing policy effectiveness are present; thus, its implementation is fragmented with limited long-term impact. These inadequacies must be addressed to develop realistic strategies that integrate the diversified interests of all stakeholders and promote effective policy implementation. From the mentioned gaps, therefore, this research can significantly improve the development and implementation of housing policy. Additionally, it will contribute to the theoretical debates and support practical applications in urban development.

Despite growing recognition of the importance of SAH, limited empirical work has been carried out to identify and validate the Critical Success Criteria (CSCs) required for delivering SAH in high-density urban contexts. CSCs represent the specific and measurable outcomes that define the project's success in relation to achieving the project's objectives (Adabre and Chan, 2019a; Ahadzie et al., 2008; Chan and Adabre, 2019; Yan et al., 2019). For policymakers, planners, and developers, this lacks standardized criteria as it is essential to implement integrative approaches relevant to specific issues in urban megacities of India. Therefore, filling this gap is necessary to study critical success criteria pertinent to SAH provision in the Indian megacity settings. The research objectives (RO) are mentioned below:

RO1: To identify, validate, and prioritize CSCs for SAH delivery in high-density Indian megacities.
RO2: Develop an integrated policy framework incorporating stakeholder perspectives to implement SAH solutions based on identified CSCs.

The outcomes of this research are critical to policymakers, urban planners, and developers of Indian megacities and other high-density cities in developing nations. It bridges the current theory-practice gap in

housing policy and urban planning by identifying CSCs in the context of context-specific interventions and developing an integrated framework. It contributes to the broader discourse concerning sustainable urban development and provides a robust foundation for designing more effective SAH initiatives. Besides, the study's expected outcomes will better align the interests of various stakeholders so that the solution provided will be equitable, sustainable, and scalable in housing in rapidly urbanizing regions.

The paper is divided into the following sections: Section Two is a comprehensive literature review that describes the research methodology for identifying and validating potential CSCs for SAH. Section Three elaborates on the analysis and findings of the empirical study and the associated prioritization of identified CSCs. Section Four elaborates on the implications of results and relevance to the broader fields in SAH. Finally, Section Five summarizes the main conclusions and gives further recommendations for practitioners, policymakers, and future research directions in SAH.

2. Research methodology

2.1 Identification of potential CSC for SAH

A literature review was conducted in multiple databases, including Web of Science, Scopus, and Google Scholar. The review scope included peer-reviewed articles, book chapters, policy documents, and reports published between 2014 and 2024. Sources were selected to identify the CSCs contributing to SAH, mainly in high-density urban areas in developing countries. In the preliminary stage, 39 CSCs were identified. The validation procedure consisted of two distinct phases. Initially, the criteria were assessed by academic professionals for their thoroughness, pertinence, and lucidity. This panel comprised two senior professors with expertise in sustainable urban development, a postdoctoral researcher concentrating on affordable housing policies, and a doctoral candidate specializing in urban sustainability metrics. Following their recommendations, three supplementary criteria—"Reduced Social Segregation," "Access to Healthcare Facilities," and "Disaster Resilience Measures"—were integrated to fill the gaps recognized during the literature validation and for the consensus among experts.

During the second phase, six experts working in affordable housing in Indian megacities—including architects, town planners, and housing development authorities—checked the feasibility of the indicators for practical implementation. Their responses brought out refinements that dealt with the interdependencies and specific conditions of the urban contexts in India. This resulted in a finalized set of 36 CSCs through an iterative process that assured academic rigor and practical relevance. Table 1 shows all the final CSCs with supporting references, which shall be further used for analysis and discussion.

Table 1. List of potential CSC for sustainable and affordable housing projects

CSC Code	CSC for Sustainable & Affordable Housing	References
CSC1	Spatial functionality of unit space	(Al-Tmeemy et al., 2011)
CSC2	Integrating renewable and sustainable strategies	(Moghayedi et al., 2021)
CSC3	Adequate incentives by the Government	(Hamidi et al., 2016)
CSC4	Low presence of environmental problems	(M.A. Adabre and Chan, 2019b)
CSC5	Rental Price V/S Income	(Albert P.C. Chan and Adabre, 2019; Saha et al., 2024)
CSC6	Reduced Social segregation	*Pilot Survey*
CSC7	Access to local commercial areas	(Gan et al., 2019)
CSC8	Public support or acceptance	(Agarwal et al., 2022)
CSC9	Pollution control initiatives	(Adabre and Chan, 2021)
CSC10	Availability of open green space	(Adabre et al., 2020)

CSC11	Quality of housing	(M.A. Adabre and Chan, 2019b)
CSC12	Environmental performance of housing facility	(Chan & Hou, 2015)
CSC13	Allowing flexibility in zoning and development standards	(Adel et al., 2022)
CSC14	Reduce the life cycle cost of Housing	(Ezennia and Hoskara, 2021)
CSC15	Timely completion of Project	(Liang and Jia, 2018)
CSC16	Good location for residential accommodation	(M.A. Adabre and Chan, 2019)
CSC 17	Cultural sensitivity in design	(Wang and Ajovalasit, 2020)
CSC 18	Disaster resilience features	(Moghayedi et al., 2021)
CSC19	Maintenance of existing houses	(Valença, 2015)
CSC20	Available waste management facilities	(Winston, 2010)
CSC21	Number of dwelling units based on Household size	(Abastante et al., 2018)
CSC22	Marketability of housing facility	(Chan & Adabre, 2019)
CSC23	Effective coordination with government bodies	(Adel et al., 2022)
CSC24	Efficient land management policies for housing supply	(Adabre et al., 2020)
CSC25	Safety and Security measures	(Chan & Adabre, 2019)
CSC26	Project completed within the allocated budget	(Gan et al., 2019)
CSC27	Appropriate risk allocation and risk sharing	(Amora and Juanzon, 2022)
CSC 28	Technology transfer	(Chan & Adabre, 2019)
CSC29	Reduced commuting cost/distance	(Adabre and Chan, 2021)
CSC30	Adequate physical infrastructure supply	(Saha et al., 2024)
CSC31	Comfortable and healthy indoor environment	(Maqbool et al., 2020)
CSC 32	Reducing various approval cost	(Chan & Hou, 2015)
CSC33	Community participation	(Ezennia, 2022)
CSC34	Housing Price V/S Income	(Lamprou and Vagiona, 2022)
CSC35	Access to employment opportunities	*Pilot Survey*
CSC36	Access to health care services	*Pilot Survey*

2.2 Data collection and survey designs

A questionnaire survey was developed to elicit experts' opinions on the importance of the identified CSCs within the SAH delivery. It comprised questions for each CSC about the relevance and importance of various dimensions of SAH delivery. Respondents were chosen based on two key selection criteria: (1) substantial contribution to research or practical knowledge in urban planning, as evident from academic writings or professional qualifications, and (2) in-depth knowledge about affordable housing schemes. The survey targeted researchers, project managers, urban planners, developers, and consultants chosen from articles in peer-reviewed journals and professional housing databases like Liases Foras and CREDAI (The Confederation of Real Estate Developers Associations of India). A snowball sampling technique was also used where primary respondents shared the questionnaire with other qualified experts within their professional network. This ensures greater generalizability and access to specialists whose niches are often left out in traditional sampling strategies (Saha et al., 2024). The questionnaire was then sent to 178 experts via email using Google Forms. For each CSF, the experts indicated the relative importance using a five-point Likert scale (1 = "not significant"; 5 = "significant"). Of the responses received, 109 were analyzed, but nine were excluded due to missing data or outliers detected. The outlier exclusions were based on statistical anomalies. Hence, 100 valid responses remain, which gives a response rate of 56%.

Respondent profiles provided a balanced representation, with 38% from academia and 62% from industry sectors such as architects, engineers, urban planners, project/construction managers, and developers. Most respondents presented considerable professional experience in affordable housing: 67% mentioned 5–10 years, 22% 11–20 years, and 11% reported more than 20 years of involvement in affordable housing

projects. Housing project experience spanned across social housing (43%), cooperative housing (25%), public housing (22%), and other specialized categories of public-private partnership developments, corporate housing, and community-led initiatives (10%). This allows for professional and sectoral heterogeneity, ensuring a holistic range of opinions and expertise over the findings. Figure 1 illustrates the methodological structure adopted in the investigation in terms of sequential phases, research methodologies, and procedures adopted. This framework presents a guide to understanding how each stage of the method applied assists in the identification and validation of CSCs.

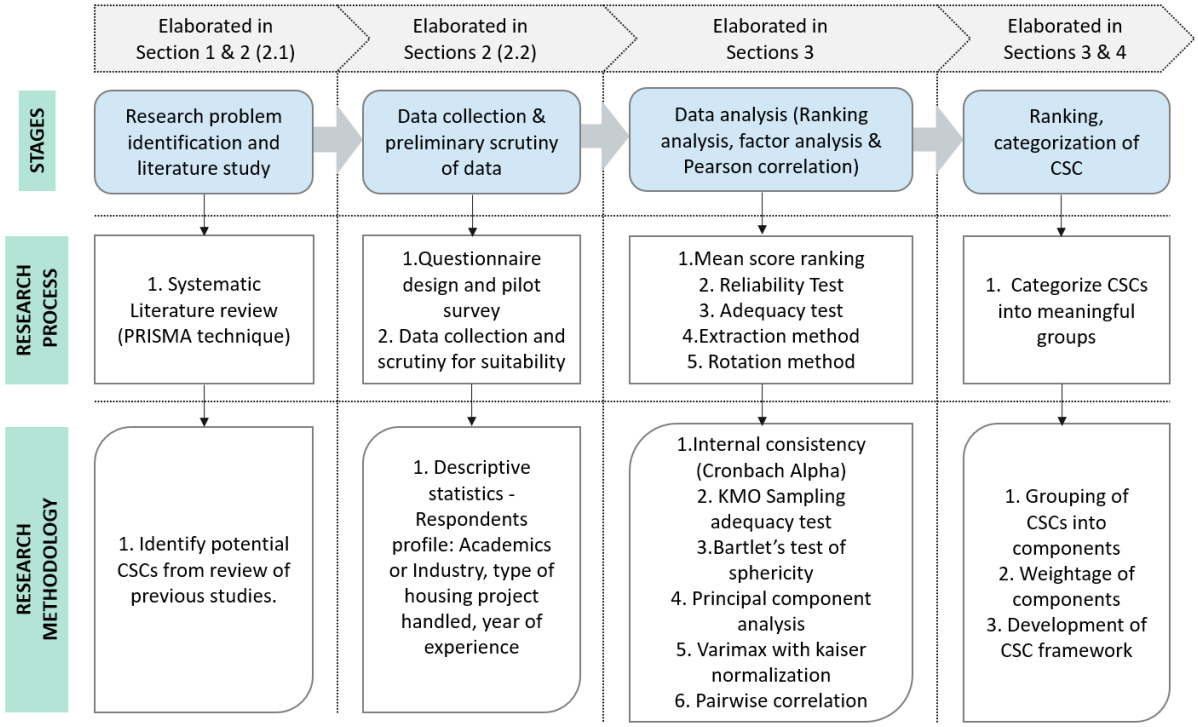

Figure 1. Research framework for the study. Source: Author.

3. Data analysis and results

Data analysis was performed using the Statistical Package for Social Science (SPSS) version 29. SPSS was chosen due to its advanced statistical modeling features and its suitability for academic research. The analytical process was divided into three main methods: (1) descriptive statistics to rank the CSCs in terms of mean value and standard deviations, (2) Pearson correlation analysis to establish relationships among the individual CSCs, and (3) factor analysis for further grouping of the 36 CSCs to components that reflect similar constructs (Ahadzie et al., 2008).

3.1. Ranking analysis of the CSCs

CSCs were ranked according to their mean values, with lower standard deviations used as a tiebreaker for identical means. Table 3 summarizes the rankings, highlighting the five highest-ranked criteria as house price versus income (CSC34, mean=4.55), lifecycle cost reduction (CSC14, mean=4.53), rental price versus income (CSC5, mean=4.52), housing quality (CSC11, mean=4.47), and residential location suitability (CSC16, mean=4.43). These results are consistent with the findings of Gan et al. (2017), where affordability metrics were similarly prioritized across stakeholders. This underscores a key challenge: while other sustainability features are essential, improvements that increase the overall costs may face resistance as they would reduce affordability for housing. Chan et al. (2018) similarly identified increases in cost as a hindering factor

in the adoption of energy-efficient technologies but stressed the use of cost-effective measures to continue the sustainability agenda without losing affordability. On the other side, the five highest-ranked criteria were cultural sensitivity in design (CSC17), approval cost reduction (CSC32), technology transfer (CSC28), disaster resilience features (CSC18), and zoning flexibility (CSC13). These criteria obtained a score of below 3.77, which marked a lower degree of perceived importance or viability in SAH scenarios. For instance, the overall low score on technology transfer corroborates with Ahadzie et al. (2008), who argue that there are inherent difficulties in integrating advanced technologies within existing frameworks.

Table 2. Ranking of CSC. Source: Author.

Code	Mean	Standard Deviation (S.D)	Normalization score	Rank
CSC1	4.42	0.622	0.930	6
CSC2	4.25	0.821	0.838	18
CSC3	4.37	0.691	0.903	12
CSC4	4.38	0.736	0.908	11
CSC5	4.52	0.703	0.984	3
CSC6	4.39	0.764	0.914	9
CSC7	4.15	0.845	0.784	25
CSC8	4.26	0.505	0.843	17
CSC9	4.37	0.734	0.903	12
CSC10	4.34	0.536	0.886	14
CSC11	4.47	0.703	0.957	4
CSC12	4.41	0.552	0.924	7
CSC13	3.77	0.863	0.578	32
CSC14	4.53	0.611	0.989	2
CSC15	4.15	0.796	0.784	25
CSC16	4.43	0.640	0.935	5
CSC17	2.7	0.870	0.000*	36
CSC18	3.28	0.889	0.314*	33
CSC19	4.13	0.812	0.773	31
CSC20	4.16	0.813	0.789	23
CSC21	4.4	0.696	0.919	8
CSC22	4.16	0.615	0.789	23
CSC23	4.17	0.711	0.795	21
CSC24	4.39	0.650	0.914	9
CSC25	4.31	0.861	0.870	16
CSC26	4.17	0.865	0.795	21
CSC27	4.24	0.605	0.832	19
CSC28	2.94	0.983	0.130*	34
CSC29	4.14	0.779	0.778	29
CSC30	4.32	0.898	0.876	15
CSC31	4.22	0.848	0.822	20
CSC32	2.74	1.031	0.022*	35
CSC33	4.15	0.821	0.784	25
CSC34	4.55	0.657	1.000	1
CSC35	4.15	0.796	0.784	25
CSC36	4.14	0.921	0.778	29

Note: Normalization Value = (Mean - Minimum Mean)/ (Maximum Mean - Minimum Mean).

*The normalization value <= 0.50 indicates that the indicator (CSC) was not critical.

Normalization analysis excluded four CSCs with values below the 0.50 criticality threshold: approval cost reduction (CSC32, normalized value=0.022), cultural sensitivity in design (CSC17, normalized value=0.000), disaster resilience features (CSC18, normalized value=0.314), and technology transfer (CSC28, normalized value=0.130). This refinement reduced the total number of CSCs from 36 to 32, which ensures that subsequent analysis focused only on criteria that substantially impact SAH outcomes.

3.2. Factor analysis

The goal of factor analysis was to find relationship patterns between the CSCs. This would allow related factors to be organized in a way that would make understanding SAH criteria easier. For the 32 CSCs to be considered reliable, they have to be validated using Cronbach's Alpha, and, in this case, α=0.706, which is greater than the acceptable level of 0.70. Two tests evaluated the adequacy of the sample for factor analysis. The value of the Kaiser-Meyer-Olkin (KMO) index of sampling adequacy was 0.669, which is higher than the established level of 0.50. Bartlett's test of sphericity (χ^2=1423.151, p<0.001) was statistically significant, which means that variables are dependent on each other (Field, 2013).

The retention parameter is based on Principal Component Analysis (PCA), which calculated 26 substantial variables using eigenvalues greater than 1.0. This ensures that the retained components capture a reasonable amount of data variance. Six components emerged from the Varimax rotation, collectively accounting for 55.46% of the total variance in this study. Such components relate to CSCs' dimensions, comprehensively explained in Table 5.

Table 3. Correlation matrix of Critical Success Criteria (CSC). Source: Author.

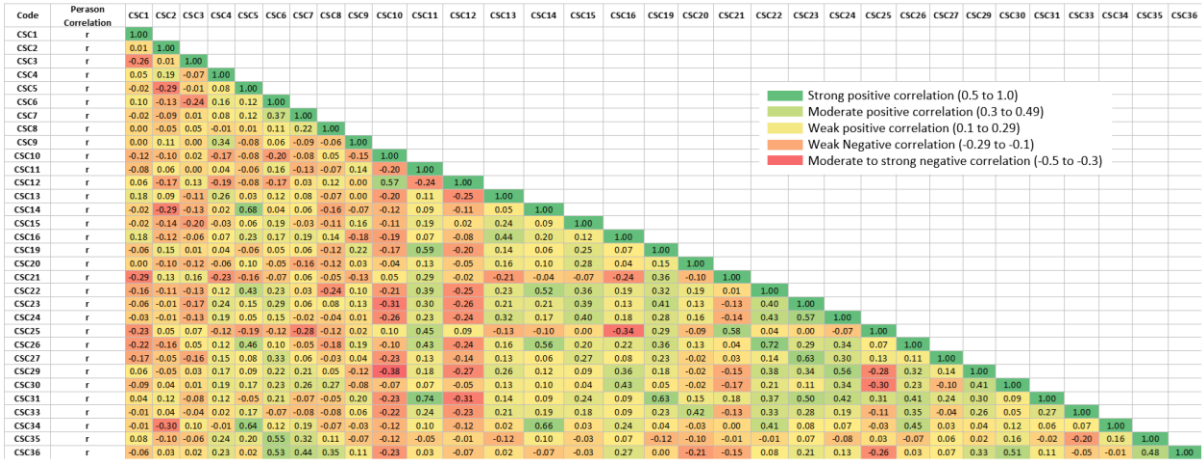

Table 4. Results of the factor analysis (rotated component matrix). Source: Author.

Component name	CSC Code	Components Loading					
		1	2	3	4	5	6
Component 1: Housing Operational cost-related CSC	CSC14	0.864	-	-	-	-	-
	CSC34	0.829	-	-	-	-	-
	CSC26	0.655	-	-	-	-	-
	CSC22	0.611	-	-	-	-	-
Component 2: Land use planning-related CSC	CSC30	-	0.729	-	-	-	-
	CSC29	-	0.724	-	-	-	-
	CSC16	-	0.637	-	-	-	-
	CSC24	-	0.508	-	-	-	-
	CSC11	-	-	0.721	-	-	-

Component 3: Housing Quality and Safety-related CSC	CSC21	-	-	0.707	-	-	-
	CSC25	-	-	0.681	-	-	-
	CSC19	-	-	0.672	-	-	-
Component 4: Project Management and governance-related CSC	CSC15	-	-	-	0.698	-	-
	CSC23	-	-	-	0.682	-	-
	CSC27	-	-	-	0.643	-	-
	CSC3	-	-	-	-0.523	-	-
Component 5: Social and Community-related CSC	CSC35	-	-	-	-	0.740	-
	CSC36	-	-	-	-	0.700	-
	CSC6	-	-	-	-	0.650	-
	CSC7	-	-	-	-	0.585	-
Component 6: Environmental Quality & sustainability-related CSC	CSC12	-	-	-	-	-	-0.659
	CSC10	-	-	-	-	-	-0.630
	CSC4	-	-	-	-	-	0.613
▪ **Eigenvalue**		5.727	3.517	2.823	2.332	1.778	1.569
▪ **Variance (%)**		17.897	10.992	8.823	7.288	5.556	4.903
▪ **Cumulative Variance (%)**		17.897	28.889	37.712	44.999	50.555	55.457

Extraction method: Principal Component Analysis.
Rotation method: Varimax with Kaiser Normalization

4. Discussion of the results

4.1. Component 1: Housing Operational Cost-related CSC

The first component addresses household operational costs and includes five significant criteria: reducing the lifecycle cost of housing, rental price versus income, housing price versus income, project completion within the allocated budget, and marketability of the housing facility. These criteria demonstrated strong factor loadings, ranging from 86.4% (lifecycle cost reduction) to 61.1% (housing marketability). This component contributed the highest variance among all six components, explaining 17.897% of the total variance (Table 5). A significant correlation between rental and housing price-to-income ratios (r=0.659, p=0.01) informed the choice of the housing price-to-income ratio as the primary affordability metric, as it offers broader insights into overall housing affordability.

Lifecycle cost reduction emerged as the most significant criterion, reflecting the cumulative costs incurred throughout a housing unit's lifespan. These include maintenance, repairs, utilities, and regular upkeep expenses (Ruparathna et al., 2016). Minimizing lifecycle costs is crucial for enhancing long-term affordability in sustainable and affordable housing. These operational considerations directly influence rental and purchase affordability metrics, affecting housing facility take-up rates (Chan & Adabre, 2019). The housing price-to-income ratio is a key indicator of homeownership feasibility. High housing costs relative to household income can negatively affect take-up rates and prolong waiting periods for potential residents (Ahadzie et al., 2008; Teck-Hong, 2012). Compliance with project budgets is critical for maintaining affordability metrics. Efficient resource utilization during construction helps prevent cost escalations, ensuring affordability for end-users (Adabre and Chan, 2019a; Agarwal et al., 2021). Adhering to financial discipline directly influences market viability by ensuring that housing developments remain operationally efficient and appealing to potential buyers or tenants. The effective integration of lifecycle cost reduction, affordability metrics, budget compliance, and marketability ensures financial sustainability and broad market acceptance, mitigating risks of low occupancy rates and prolonged allocation periods (Al-Tmeemy et al., 2011).

4.2. Component 2: Land use planning-related CSC

The land use planning component explains 10.992% of total variance (Table 5), encompassing four critical success components: adequate physical infrastructure supply (72.9%), reduced commuting costs and distances (72.4%), strategic residential location (63.7%), and efficient land management policies (50.8%).

Land use planning optimizes land utilization through agglomeration economies and public infrastructure development (Crook, 1996). While infrastructure enhancement increases land value through communal benefits, it reduces available land for housing development. Planning authorities address this through value capture mechanisms, implementing developer taxes and levies on infrastructure-derived capital gains. These revenues support affordable housing initiatives, establishing a crucial link between land-use planning systems and housing finance (Whitehead, 2007). Strategic residential locations for low-income households are better served through mixed-land-use developments, enhancing economic and social sustainability (Adabre and Chan, 2019b). This integrated approach combines residential, commercial, and office spaces, reducing commuting costs and fostering walkable neighborhoods. The agglomeration economies facilitate better service access, reduced energy consumption, and efficient resource distribution, benefiting low-income residents through improved accessibility to essential services and employment opportunities (Koster and Rouwendal, 2012).

4.3. Component 3: Housing Quality and Safety related CSC

This component accounts for 8.823% of the total variance, encompassing critical criteria with significant factor loadings: quality of housing (72.1%), dwelling units based on household size (70.7%), safety and security measures (68.1%), maintenance of existing houses (67.2%), and comfortable indoor environment (62.6%). The analysis reveals a robust correlation between comfortable indoor environments and overall housing quality ($r=0.740$, $p=0.01$), manifesting in both “quality in fact” (technical specifications, material standards, and construction processes) and “quality in perception” (resident satisfaction and lived experience). Neglecting perceived quality can lead to housing abandonment (Arditi and Gunaydin, 1997). Housing quality optimization requires functional interior layouts with adequately sized living spaces, strategic room arrangements, and sufficient storage areas (Ren & Folmer, 2017). Privacy considerations through appropriate bedroom numbers and sizes and adequate bathroom facilities are particularly significant for low-income households, with living space emerging as the most reliable quality indicator (Opoku and Abdul-Muhmin, 2010). Living space has emerged as the most reliable quality indicator among these design features.

Safety and security elements encompass well-lit public areas, secure parking facilities, protected indoor spaces, and child-safe public areas. Security features, including neighborhood crime rates and gated community status, significantly influence residential satisfaction and home ownership decisions, particularly among first-time buyers (Teck-Hong, 2012). Combining secure environments with quality leisure facilities enhances residential satisfaction (Ren and Folmer, 2017). Regular needs assessments before and during project implementation ensure that technical standards and resident expectations are consistently met throughout the project lifecycle (Adabre and Chan, 2019a).

4.4. Component 4: Project Management and governance-related CSC

The fourth component, explaining 7.288% of the total variance, includes timely completion of the project (69.8%), effective coordination with government bodies (68.2%), appropriate risk allocation and risk sharing (64.3%), and adequate incentives by the government (-52.3%).

Timely project delivery is crucial for reducing low-income earners' waiting time and preventing construction disputes that could arise from delays (Sambasivan and Soon, 2007). This requires effective coordination with government bodies throughout the project lifecycle, particularly in navigating regulatory requirements and securing necessary approvals. The success of such coordination is enhanced through appropriate risk allocation, where private developers manage development-related risks (design, building, operation, and maintenance), while governments handle non-commercial risks and regulatory oversight (Abdul-Aziz and Jahn Kassim, 2011). Government incentives are crucial in ensuring project viability through various mechanisms: land allocation, low-interest financing, design flexibility, density bonuses, and fee concessions. For instance, the United Kingdom implements mandatory policies through section 106 (S106), while Australia and New Zealand provide low-interest finances for inclusionary affordable housing projects. Singapore's land allotment system, supported by strong public ownership, has proven effective in affordable housing delivery (Adabre and Chan, 2019b). These incentives and streamlined approval processes through effective government coordination contribute to economic sustainability and price affordability while maintaining project timelines.

4.5. Component 5: Social and Community-related CSC

The fifth component, explaining 5.556% of the total variance, contains four CSCs: access to employment opportunities (74%), access to health care services (70%), reduced social segregation (65%), and access to local commercial areas (58.5%). This component accounted for 5.556% of the total variance (Table 5).

Access to employment opportunities emerges as the most significant factor within this component, as housing locations facilitating easy access to work directly impact household economic stability and long-term affordability. Research indicates that proximity to employment centers reduces transportation costs and commuting time, effectively increasing disposable income for housing expenses (Agarwal et al., 2021; Ballous and Bashir, 2022). Healthcare accessibility plays a crucial role in sustainable housing development, with proximity to medical facilities particularly vital for low-income households facing mobility constraints. The correlation between healthcare access and housing success extends beyond physical proximity, including the affordability and quality of available medical services.

Reducing social segregation through mixed-income developments fosters community integration and social sustainability. When affordable housing projects are strategically integrated within existing neighborhoods rather than isolated in peripheral locations, they promote social cohesion and reduce the stigmatization of low-income residents (Agarwal et al., 2021; Moghayedi et al., 2021). This integration is further enhanced by access to local commercial areas, which provide essential services and create opportunities for local employment and community interaction. The presence of diverse commercial facilities within walking distance contributes to neighborhood vitality and reduces transportation expenses for daily necessities (Chan & Adabre, 2019).

4.6. Component 6: Environmental Quality and Sustainability-related CSC

The sixth component, explaining 4.903% of the total variance, comprises three environmental criteria: environmental performance of housing facility (65.9%), availability of open green space (63%), and low presence of environmental problems (61.3%).

The environmental performance of housing facilities is a critical determinant of long-term sustainability, encompassing energy efficiency, water conservation, and resource optimization. Efficient environmental performance reduces operational costs for low-income residents through lower utility bills and enhances the overall quality of life through improved indoor environmental quality(Adabre & Chan, 2019a; Chan & Adabre, 2019). The availability of open green spaces contributes dual benefits: providing recreational areas

that enhance community well-being while simultaneously serving environmental functions such as natural ventilation, reduced urban heat island effects, and improved air quality. Studies indicate that access to green spaces correlates positively with residential satisfaction and community engagement in affordable housing developments (Agarwal et al., 2022, 2021).

Minimizing environmental problems, including air pollution, noise levels, and waste management issues, directly impacts housing success through improved health outcomes and reduced maintenance costs. Low-income communities often face disproportionate exposure to environmental hazards, making this criterion particularly significant for SAH initiatives. Integrating these environmental considerations into housing design and planning ensures both immediate livability and long-term sustainability, contributing to the overall success of affordable housing projects through reduced operational costs and enhanced resident well-being Chan and Adabre, 2019; Lamprou and Vagiona, 2022).

4.7 Relevance and Integration of CSC Components for SAH

The empirical analysis reveals six distinct but interconnected components essential for SAH delivery: Housing Operational Cost, Land Use Planning, Housing Quality and Safety, Project Management and Governance, Social and Community aspects, and Environmental Quality and Sustainability. These components demonstrate strong interdependencies across economic, social, and environmental dimensions of sustainability. Housing Operational Cost (Component 1), explaining the highest variance (17.897%), fundamentally influences economic and social sustainability. The strong correlation between lifecycle costs and housing affordability metrics ($r=0.659$, $p=0.01$) demonstrates how operational efficiency directly impacts housing accessibility for low-income residents. This component's integration with Land Use Planning (Component 2, 10.992% variance) is evident through the relationship between infrastructure development and housing costs, where strategic location choices influence initial and long-term affordability.

Housing Quality and Safety (Component 3, 8.823% variance) bridges social and economic sustainability through its significant correlation between indoor environment quality and overall housing satisfaction ($r=0.740$, $p=0.01$). This component's success criteria directly influence residential take-up rates and long-term occupancy, demonstrating its crucial role in project viability. Project Management and Governance (Component 4, 7.288% variance) facilitates the implementation of these quality standards through effective coordination and risk management, ensuring that sustainability goals align with practical delivery constraints. The Social and Community component (Component 5, 5.556% variance) enhances social and economic sustainability by strategically integrating housing with essential services and employment opportunities. This integration is reinforced by Environmental Quality and Sustainability measures (Component 6, 4.903% variance), where green spaces and environmental performance contribute to both community well-being and operational efficiency.

The interdependencies between these components highlight that successful SAH requires a holistic approach. For instance, environmental performance improvements (Component 6) can reduce operational costs (Component 1), while strategic land use planning (Component 2) enhances both social integration (Component 5) and project viability (Component 4). This integrated framework demonstrates that sustainability in affordable housing is achieved not through isolated interventions but through carefully balancing and optimizing all six components (Figure 2).

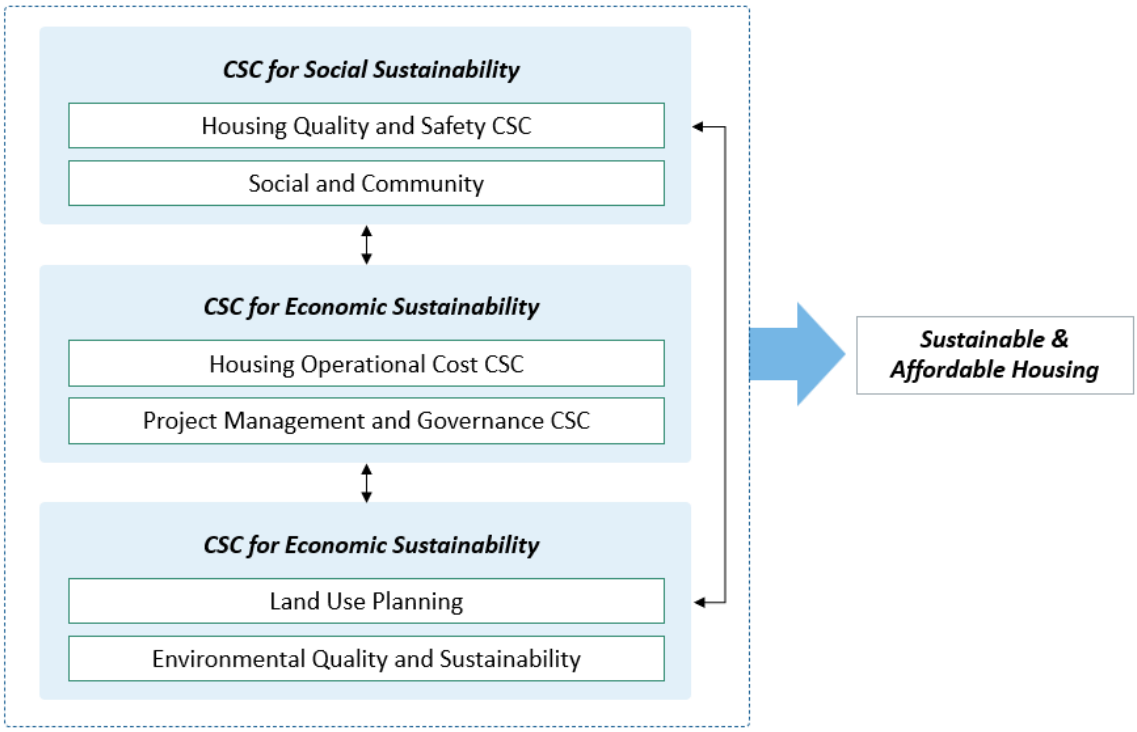

Figure 2. A framework for sustainable affordable housing. Source: Author.

5. Conclusions

This study investigated the CSCs for SAH delivery in high-density urban areas, mainly focusing on Indian megacities. Through comprehensive analysis of 100 expert responses and subsequent factor analysis, six distinct components emerged as fundamental to SAH's success: Housing operational cost, land use planning, housing quality and safety, project management and governance, social and community aspects, and environmental quality and sustainability. The findings reveal that while cost-related criteria maintain primary importance (explaining 17.897% variance), successful SAH delivery requires a more holistic approach integrating multiple sustainability dimensions. The analysis demonstrated significant correlations between various CSCs, such as the relationship between indoor environment quality and overall housing satisfaction ($r=0.740$, $p=0.01$), highlighting the interconnected nature of these success criteria.

Several critical theoretical and practical implications emerge from this research. It contributes to the affordable housing literature by providing an empirically validated framework of CSCs specifically contextualized for high-density urban environments while bridging the gap between sustainability and affordability by identifying and prioritizing criteria that serve both objectives. The findings suggest that successful SAH implementation requires careful consideration of all six components rather than focusing solely on economic metrics. For practitioners and policymakers, this research offers actionable insights: development authorities can utilize these CSCs for more effective resource allocation and project planning; urban planners can better integrate sustainability considerations with affordability objectives; housing developers can enhance project success by addressing all identified components systematically; and policymakers can develop more comprehensive housing policies that balance economic, social, and environmental factors.

The study has limitations, as the analysis focused primarily on expert opinions from academia and industry, potentially excluding valuable insights from housing residents. Additionally, while the response rate was

adequate (56%), a larger sample size could enable more detailed statistical analysis across different stakeholder groups. Future research could incorporate resident/household perspectives on SAH success criteria, conduct comparative analyses across different megacities, develop specific implementation frameworks for each component, and investigate the economic implications of implementing comprehensive sustainability measures in affordable housing. Despite these limitations, this research provides a robust foundation for understanding and implementing successful SAH projects in high-density urban environments. The findings underscore that while affordability remains crucial, long-term success requires careful consideration of all identified components, suggesting the need for integrated housing policy and development approaches.

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