

Original Article

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Assessment of social sustainable development indicators in Iranian satellite cities: a case study of the city of Qarchak

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Abstract

The rapid expansion of satellite cities surrounding metropolitan areas such as Tehran, driven by the dominance of physical and engineering-oriented approaches over social dimensions, has resulted in profound crises in the realm of social sustainability. This study aims to assess the status of social sustainable development in the city of Qarchak and to identify the fundamental drivers of unsustainability, with particular emphasis on modeling causal relationships among indicators. The research adopts an applied–developmental approach with a descriptive–analytical design. Data were collected through a structured five-point Likert-scale questionnaire administered to 47 experts, urban managers, and planners. Data analysis was conducted using one-sample t-tests, the Wilcoxon test, and partial least squares structural equation modeling (PLS-SEM). The statistical findings indicate that the overall level of social sustainability in Qarchak is in a critical condition, with an aggregate mean score of 2.22. At the same time, the dimension of spatial and physical justice exhibits the weakest performance, with a mean value of 2.04. The results of confirmatory factor analysis (CFA) reveal that access to education (factor loading = 0.728) and trust in urban management (factor loading = 0.79) are the most influential drivers of social sustainability. The key innovation of this study lies in conceptualizing the mechanism of physical failure–social erosion, demonstrating that inequalities in the distribution of urban services are not merely technical shortcomings but constitute a fundamental factor in the formation of perceived discrimination and the erosion of place attachment. The findings underscore the urgent need to revise urban development plans in Qarchak and to strengthen local governance with a focus on the reproduction of spatial justice.

Keywords

Assessment
Sustainable development indicators
Social sustainability
Satellite cities
Qarchak City

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1. Introduction

Against the backdrop of the accelerating pace of urbanization at both global and national scales, metropolitan areas—acting as primary nodes of economic growth and population concentration—have encountered substantial structural barriers to achieving sustainable livability (Hasnath, 2024). In Iran, the concentration of facilities and opportunities in major metropolises such as Tehran, coupled with the rapid growth of the urban population, has rendered the formation of peripheral and satellite cities an unavoidable necessity (Rabiei-Dastjerdi, 2023). The development of these cities began in the 1980s as a planned response to crises arising from excessive population concentration in core metropolitan areas (Janakipour et al., 2022). The initial objectives of this policy included redistributing part of the metropolitan population, providing affordable housing, creating local employment opportunities, ensuring independent urban services, and reducing daily commuting to the parent metropolis (Dzhamaludinova & Magomedova, 2024). However, shifts in population settlement patterns and the unbalanced growth of migration flows have, over time, exposed these settlements to multiple crises in urban sustainability, particularly within the social dimension. The consequences of this condition are evident in the emergence and intensification of social problems such as an increase in child labor, the spread of delinquency, theft, urban violence, and the deepening of social inequalities (Canbulut, 2025). Under such circumstances, the concept of sustainable urban development, as a comprehensive framework, emphasizes the need to balance economic, environmental, and social dimensions in order to enhance the quality of life for the present generation without compromising the interests of future generations (Campos-Sánchez et al., 2022). Among these three dimensions, social sustainable development—grounded in principles such as spatial justice, social security, social cohesion and solidarity, active citizen participation, preservation of collective identity, and equitable access to opportunities and services (Feng & Hou, 2023)—has been largely neglected in many of Iran's satellite and peripheral cities, emerging as a critical challenge. The city of Qarchak, located in the southeastern part of Tehran Province, represents a prominent example of such settlements. Due to rapid in-migration, disorderly physical expansion, and the inefficiency of urban development plans, Qarchak has been confronted

with a wide range of social, economic, cultural, and spatial anomalies (Hosseini et al., 2024). Documented evidence from scholarly articles and academic theses indicates that the level of implementation of strategic planning approaches grounded in social sustainability in Qarchak remains considerably low. As a result, the scores of key sub-indicators of social development in this city have declined significantly (Mahdii, 2024). These conditions are primarily attributed to the insufficiency and poor quality of social services, the lack of equal opportunities, weaknesses in mechanisms for enhancing public participation, and deficiencies in service infrastructure (Pérez, 2025). The livability of Qarchak is influenced by a constellation of overt and latent factors that have led to consequences such as rising delinquency, declining social trust, and a weakening sense of citizen belonging (Keller, 2024). Such conditions underscore the need for an in-depth and systematic investigation and have elevated strategic attention to these issues as an emerging theme within the field of sustainable urban development (Shevchenko & Shevchuk, 2024). The central objective of this study is to conduct a comprehensive assessment of the extent to which social sustainable development indicators have been realized in Qarchak, relying on empirical evidence to identify strengths and weaknesses and to determine critical priorities. The key research question addresses how Qarchak—one of Iran's influential satellite cities—performs in achieving social sustainable development indicators and which indicators contribute most significantly to the emergence of social unsustainability. Previous studies have predominantly focused on social sustainable development in metropolitan areas. However, satellite cities, due to their distinctive characteristic of functional dependency on the parent metropolis, follow a different logic in terms of social sustainability. Moving beyond a purely descriptive approach, this article seeks to elucidate how the dormitory-based urban structure and spatial fragmentation in such cities directly affect social sustainability indicators. The significance of this study can be articulated at two levels. From a theoretical perspective, the research concentrates on a relatively underexplored domain—namely, the assessment of social sustainable development indicators in Iran's satellite cities, which possess social and physical characteristics distinct from those of major metropolises. By doing so, it addresses an existing gap in the urban planning literature and proposes a context-sensitive model for understanding the

mechanisms underlying social unsustainability. From a practical standpoint, the findings provide urban managers and decision-makers with precise and actionable insights, enabling them to adopt an integrated and strategic approach to designing or revising policy documents and implementing targeted spatial and social interventions aimed at enhancing justice, strengthening participation, and improving the quality of life of residents in Qarchak and other comparable cities. The innovation of this research manifests in two fundamental aspects. First, it selects Qarchak as a representative case of settlements characterized by high population growth rates and complex social challenges that have not yet been comprehensively evaluated. Second, it employs a set of social sustainable development indicators derived from international sources and adapted to the cultural, economic, and social conditions of Iran's satellite cities. These indicators are examined and prioritized through a quantitative-analytical approach at the neighborhood level in Qarchak. Moreover, the study emphasizes the necessity of engaging a broad spectrum of stakeholders—from governmental institutions to civil society organizations and local communities—to ensure that the needs and expectations of all groups are incorporated into the planning process, thereby achieving outcomes that are both inclusive and sustainable. The innovation of this study lies in the theoretical development of the concept of “dependent social sustainability.” By examining the causal mechanisms between rapid physical growth and the disruption of social relations, this article proposes a novel model demonstrating that, in satellite cities—unlike in parent metropolises—social sustainability is primarily a function of exogenous variables (such as metropolitan decentralization policies) rather than endogenous factors. Ultimately, this strategic framework enables the transformation of the weaknesses and threats faced by satellite cities such as Qarchak into opportunities and capacities for sustainable development. Following the articulation of the theoretical foundations and methodological framework, the article introduces the selected indicators, analyzes the current condition of Qarchak, and proposes practical strategies aimed at achieving socially sustainable development.

2. Theoretical foundations

The concept of sustainable development emerged as a strategic response to the escalating environmental crises and widening social disparities of the latter half

of the twentieth century. Its formal and theoretical culmination is widely recognized in the landmark Brundtland Report, *Our Common Future*, published in 1987 by the World Commission on Environment and Development. This report defined sustainable development as a process capable of meeting the needs of the present generation without compromising the ability of future generations to meet their own needs (Yigit, 2024). In recent decades, with the acceleration of urbanization, this concept has entered the realm of urban planning, centering on three fundamental pillars: economic, environmental, and social sustainability (Veckalne & Tambovceva, 2023). The significance of urban sustainability lies in the fact that cities simultaneously represent the primary sources of global unsustainability and the most promising arenas for addressing and resolving such challenges (Boca Santa et al., 2024). Among these three dimensions, the social dimension has gained increasing prominence and, according to some scholars, constitutes the foundational infrastructure upon which the other two dimensions are formed and sustained (Atalay & Švagždienė, 2023). Social sustainability emphasizes the continuous enhancement of the quality of life and human well-being. It encompasses key elements such as equity in the spatial distribution of services, security, participation, social cohesion, preservation of collective identity, and equality in access to opportunities (Tonón et al., 2024). Spatial justice, from the perspective of scholars such as David Harvey, refers to the equitable allocation of urban resources in a manner that prevents the reproduction of spatial inequalities (Schwanen, 2025). Alongside this, indicators such as active participation and social cohesion are directly linked to the concept of social capital—capital that is formed through norms, trust, and social networks and that facilitates cooperation and the pursuit of collective interests (Puentes et al., 2021). From an urban planning standpoint, neglecting these indicators and weakening social capital leads to a tangible decline in quality of life and an intensification of urban unsustainability (Rao, 2025). In Iran, the formation of satellite cities began in the 1980s with the aim of absorbing surplus metropolitan populations and providing affordable housing (Basirat & Arbab, 2022). Despite these initial objectives, such cities, due to the failure to achieve economic and service self-sufficiency, rapidly assumed the role of dormitory settlements with strong dependency on parent metropolitan centers such as Tehran (Niazi & Yar,

2022). This dependent structure has created fertile ground for the emergence of profound social unsustainability (Sustainable Human Habitats Development, 2023). A salient example of this condition is Qarchak, where rapid population growth driven by migration and largely unplanned development has given rise to challenges, including the expansion of informal settlements, shortages of critical infrastructure, inadequate welfare services, and a severe erosion of the strategic principles of social sustainability (Pilehvar, 2021). The decline in the scores of social indicators in this city has resulted in consequences such as increased crime, public distrust, and the erosion of a collective sense of belonging. Therefore, a rigorous and systematic assessment of social sustainability indicators emerges as an unavoidable necessity, enabling the formulation of strategic programs and the effective engagement of governmental sectors, civil society organizations, and local communities to transform existing weaknesses and threats into sustainable development opportunities.

3. Research background

The research background on the assessment of sustainable urban development—particularly its social dimension within the context of satellite cities—can be examined across two main domains: domestic and international studies. These studies have primarily focused on explaining the concepts, principles, and strategies for achieving sustainable development through a variety of theoretical and empirical approaches. Alizadeh Ghanad and Mabhout (2015) conceptualize sustainable urban development as being grounded in social, spatial, and environmental justice, emphasizing the necessity of assessing its economic and social dimensions to ensure citizen welfare and rights. Similarly, Masood and Rana (2011), in their study of the city of Dhaka, examine the challenges and strategies of sustainable development and highlight the central role of government and the planning system in guiding development trajectories. Sarafi et al. (2009) employ the City Development Strategy (CDS) approach to analyze the conditions of urban unsustainability in Shabestar, proposing strategies such as enhancing public participation, community empowerment, and integrated urban management. Dehshiri (2015) regards globalization as a constructive capacity for securing sustainable urban development and underscores the interaction among the three domains of economy, technology, and the

environment. Vafaei and Yahyapour (2017), through a case study of Kashan, similarly stress the necessity of formulating strategic planning frameworks to address urban challenges and achieve urban sustainability. Ziyari et al. (2019) identify social justice and the reduction of regional inequalities as the foundations of sustainability and emphasize the role of community-based programs and citizen participation in their realization. In the study conducted by Moein-Mohammadi (2015), the relationship between natural land characteristics and social structures is identified as a key determinant in achieving sustainable development, with ecological, social, and economic compatibility serving as the central axis of analysis. Shokohi et al. (2012), in their evaluation of the population-attractiveness factors of satellite cities, identify proximity to the metropolis, land costs, and access to labor markets as the most influential variables. Barzegar et al. (2018), in a study of small cities, assess the state of physical sustainability as weak and introduce the lack of basic infrastructure, inadequate services, and inefficient management as the principal barriers. Farshchin and Ramazani (2015) consider the inefficiency of traditional urban planning paradigms in Iran to be the primary driver of unsustainability and emphasize the need for a fundamental revision of the urban governance system. Similarly, Javad Mahdizadeh (2021) attributes the failure of comprehensive urban plans to institutional fragmentation, weak supervision, and inflexible regulations. Prozen et al. (2018), focusing on sustainability indicators at the neighborhood scale, examine four dimensions—environmental, socio-cultural, economic, and physical—and identify measures such as strengthening urban open spaces, enhancing security, and promoting economic activities as the most effective strategies. Another body of research has been devoted to examining the position and role of satellite cities within Iran's urban system. These studies essentially evaluate the failure of such cities to achieve employment and service self-sufficiency, analyzing them as dependent settlements lacking an independent identity. Although most of these studies do not explicitly focus on social sustainability, they identify deficiencies in infrastructure and weaknesses in urban service provision as key contributors to social unsustainability (Gorjian, 2025).

Within the domain of social sustainability studies, research conducted in Iranian urban areas—particularly in Tehran and its peripheral

neighborhoods—has sought to identify barriers to achieving social sustainability. These studies highlight spatial inequalities in the distribution of services, low levels of security, and weak local governance as fundamental challenges in this field (Ghanbari & Rashti, 2017). International studies have predominantly concentrated on developing quantitative models and indicators for assessing various dimensions of urban sustainability. Scholars such as Ebaid (2024) emphasize the necessity of simultaneously evaluating indicators across the economic, social, and environmental dimensions, considering this integration a prerequisite for comprehensive urban planning. In the field of social sustainability, recent research has focused on the roles of institutions, governance structures, and urban policymaking, underscoring the importance of components such as social equity, citizen participation, and social cohesion as the foundations of sustainability (Singh, 2024). Regarding peripheral and satellite cities, the global academic community has extensively examined the phenomenon of urban sprawl. This process has weakened social ties, reduced functional diversity, and increased the dependency of these areas on central cities. The findings of these studies stress the necessity of achieving functional self-sufficiency and strengthening the economic and social infrastructure of satellite cities (Buxton, Carey, & Phelan, 2016). In Iran, the formation of satellite cities around major metropolises such as Tehran was initially intended to absorb surplus populations and provide housing for low-income groups. In practice, however, due to the failure to achieve employment and service self-sufficiency, these settlements have evolved into dependent, predominantly dormitory-like areas. This dependent structure has generated consequences such as cultural and social heterogeneity resulting from concentrated migration, the weakening of trust networks and social capital, a diminished sense of place attachment, and widespread infrastructural deficiencies (Gorjian, 2025). From a theoretical perspective, although domestic studies have addressed urban sustainability and social unsustainability through various research efforts, they have often remained limited to broad analyses of metropolitan areas and have paid relatively little attention to the specific context of satellite cities (Ghanbari & Rashti, 2017). A review of the existing literature reveals an analytical gap regarding the social sustainability of peripheral settlements in Iran, as most previous studies have predominantly focused on the physical and environmental dimensions. This study seeks to

address this gap by adopting a context-sensitive approach and employing partial least squares structural equation modeling (PLS-SEM) to examine the linkages between perceived social sustainability indicators and the strategic planning framework in a representative satellite city—Qarchak. Such an approach can contribute to refining decision-making patterns in the urban management of similar areas. Accordingly, the few studies that have conducted more detailed analyses of Qarchak indicate that strategic planning principles centered on social sustainable development have not been effectively implemented in the city. This shortfall has resulted in a significant decline in critical indicators of security, equity, and social cohesion, ultimately exacerbating urban dysfunctions. Therefore, the necessity of adopting a comprehensive, integrative approach—emphasizing spatial justice, social capital, and inclusive stakeholder participation, ranging from governmental institutions to civil society organizations and local communities—becomes increasingly evident. In line with this perspective, the primary objective of the present study is to conduct a rigorous assessment of social sustainable development in Qarchak and to bridge the existing scientific gap through the application of theoretical frameworks grounded in spatial justice and social capital.

4. Conceptual model based on theoretical linkages

The empirical model of this study is grounded in the interaction of three primary theoretical foundations, each of which elucidates a distinct aspect of social sustainability in Qarchak:

1. Spatial justice dimension: Drawing on David Harvey's (1973) theory of Social Justice and the City, the concept of spatial justice extends beyond a purely physical understanding to encompass equity in access to opportunities in this study. Accordingly, the items related to the distribution of urban services in the confirmatory factor analysis (CFA) model reflect the principle of the "right to the city" and the equitable allocation of resources within Harvey's theoretical framework.
2. Social capital dimension: Based on the perspectives of Putnam and Coleman, social capital is conceptualized as the "binding glue of urban sustainability." Within the empirical model, this concept is operationalized through variables such as trust and participation; in other words, in the structural model, social capital is not treated as an independent variable but as an

outcome of spatial justice.

3. Security and institutional sustainability dimension: Inspired by theories of effective urban governance, this dimension is integrated into the conceptual model as a sustaining factor that ensures the continuity of the preceding two dimensions.

Accordingly, the empirical model does not rely solely on statistical relationships but represents an integrated theoretical construct in which spatial justice functions as the causal driver, shaping social capital as a mediating process, and ultimately leading to the realization of social sustainability as the outcome. This process is meaningfully situated within the context of institutional structures and urban governance, highlighting the interdependence of justice, social cohesion, and governance in achieving sustainable urban development.

5. Research methodology

From the perspective of research objectives, the present study falls within the category of applied–developmental research, as its ultimate goal is to assess the current status of social sustainability in Qarchak and provide actionable strategies and principles for strategic urban planning to enhance it. In terms of nature, the study adopts a mixed-methods approach and employs a descriptive–analytical design. In the descriptive phase, theoretical foundations related to social sustainable development and its indicators were examined through documentary and library-based sources. Selected indicators were adapted to the local conditions of Iranian satellite cities. In the analytical phase, the current status of these indicators in the case study of Qarchak was evaluated and interpreted using field-collected data. This research is grounded in the Interpretive Paradigm, which recognizes that objective data alone—such as the number of parks or public facilities—cannot fully explain the quality of life. Accordingly, expert perceptions were employed as a meta-analytical reference, given that urban experts possess comprehensive knowledge of both objective (statistical) and subjective (community needs) dimensions, enabling them to provide an integrated representation of social livability. Consequently, the results of this study are not presented as purely

objective statistics but as specialized assessments of social sustainability. The data collection instrument was a researcher-developed questionnaire based on a Likert scale, designed to measure expert perceptions and evaluations regarding the status of social indicators. The study population comprised specialists in urban planning, urban management, and city governance, including executive managers of Qarchak and relevant university faculty members. This group was selected due to their deep understanding of both the structural and social dimensions of the city, ensuring the collection of valid qualitative and quantitative data. Considering the complexity and multidimensionality of social sustainable development indicators in satellite cities, it was necessary to adopt an expert-based assessment approach. Accordingly, the study population was not drawn from ordinary citizens but purposefully selected from a pool of experts, including senior urban managers, urban planners, sociologists, and specialists in sustainable development, each with at least ten years of relevant experience. The sample size was determined to be 47 individuals using a judgmental purposive sampling method. Although general survey studies typically require larger sample sizes, in research focusing on structural equation modeling (SEM) for assessing construct validity within small expert communities, this sample size is considered sufficient based on prior scholarly guidance. This sufficiency is justified by the fact that precise and informed responses from experts reduce error variance and enhance the accuracy of the model in small-sample contexts. The validity of the data collection instrument was confirmed through both face and content validity, with input from academic supervisors, consultants, and field experts. Reliability was assessed using Cronbach’s alpha, with results presented in Table 1. Since alpha values for all leading indicators (planning, organization, and guidance) exceeded 0.7, the instrument was deemed to possess an acceptable level of reliability. For the data analysis phase, multivariate analytical techniques and inferential statistical tests were employed. To ensure robust results and mitigate limitations associated with the expert sample size ($n = 47$), the analysis process was conducted across three cross-sectional levels, as detailed in the following section.

Table 1. Cronbach’s alpha results

Cronbach’s alpha	Number of items
0.86	22

Table 2. Connectivity matrix and purpose of statistical tests in the study

Methodological rationale	Role in the study	Statistical tool	No.
Determine the type of tests based on the normality of distribution (Table 4)	Data screening	K-S & Shapiro-Wilk	1
Assess mean differences at the first layer (Table 3)	Parametric analysis	One-sample t-test	2
Sensitivity check; confirm t-test results under uncertain distribution conditions	Non-parametric analysis	Wilcoxon test	3
Confirm the independence of the four dimensions and the discriminant validity.	Construct validity	CFA / Fornell-Larcker	4
Demonstrate the model's predictive capability beyond the observed data	Model quality assessment	Blindfolding (Q^2)	5

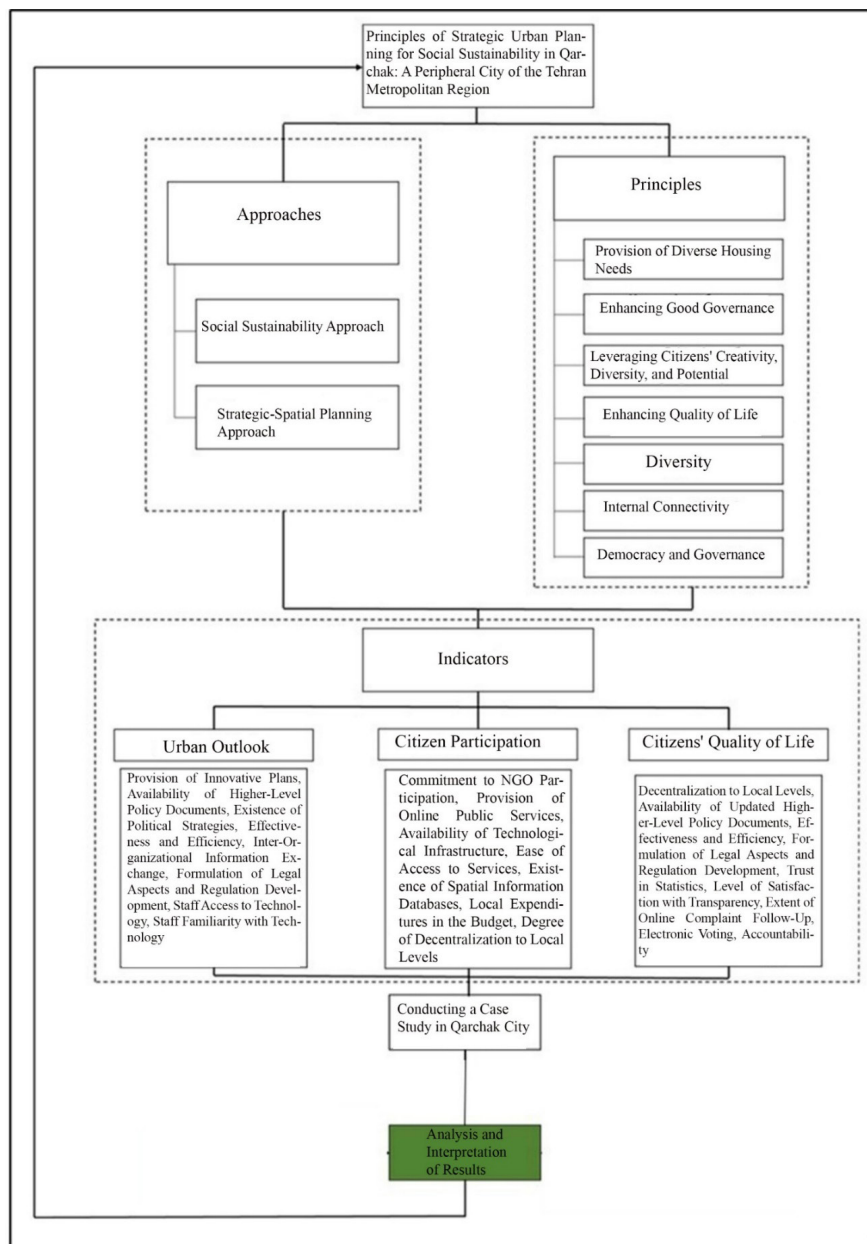


Figure 1. Conceptual model of the study

6. Data analysis

Descriptive Findings: Table 3 shows the distribution of

questionnaires among expert respondents out of a total of 47 individuals.

Table 3. Distribution of questionnaires among expert respondents (n = 47)

Description	Number of respondents	Expert category	No.
Faculty members specialized in urban management	23	University faculty	1
Officials responsible for urban affairs	14	Municipal experts	2
Managers from municipal and executive departments	10	Executive managers	3

Based on the data analysis, among the 47 respondents, 32 individuals (68.1%) were male, and 15 individuals (31.9%) were female. This statistical distribution is

presented in Table 4 and indicates a relative predominance of male respondents within the study's expert population.

Table 4. Distribution of respondents by gender

Gender	Frequency	Percentage (%)
Male	32	68.1
Female	15	31.9
Total	47	100

6.1. One-t-test

The results of the one-sample t-test, presented in Table 5, provide a detailed picture of the status of strategic planning components in Qarchak. According to the findings, the mean scores of expert opinions across all the measured dimensions are significantly lower than the theoretical mean (3). Specifically, the component "citizens' quality of life" reported a mean of 2.6 with $t = 24.5$, while "citizen participation" had a mean of 3.2 with $t = 30.8$. Comparative analysis indicates that although the citizen participation indicator is relatively better positioned than other components, the mean gap of approximately 0.6 points on the five-point Likert scale, along with the substantial difference in t-values, reflects discrepancies

in the distribution of social sustainability priorities across the city. Furthermore, the component "urban vision" received the lowest score among the examined indicators, with a mean of 2.4 and a standard deviation of 0.383. Since the significance level (Sig) for all tests is 0.000—well below the 0.05 threshold—the hypothesis of inequality between the observed means and the theoretical value is confirmed. Accordingly, the hypothesis stating that the status of social sustainability components in Qarchak is unfavorable is accepted with 95% confidence. These results provide strong statistical evidence of a noticeable gap between the current conditions and the standards of sustainable urban planning in the city.

Table 5. One-sample t-test results for strategic planning components

Component	Sample size	Mean	Standard deviation	T-value	95% confidence interval	
				upper	lower	
	47	2.6	0.309	24.5	3	2
	47	3.2	0.374	30.8	4	3
	47	2.4	0.383	28.6	4	2

6.2. Kolmogorov–Smirnov test

To determine the appropriate statistical approach—parametric or non-parametric—the assumption of normality of the data distribution was evaluated using both the Kolmogorov–Smirnov (K–S) and Shapiro–Wilk

tests. The results, presented in Table 6, show that the K–S statistics for the indicators "quality of life," "citizen participation," and "urban vision" were 0.226, 0.226, and 0.175, respectively. Given the sensitivity of the Shapiro–Wilk test in small samples ($n = 47$), its values

were also calculated for these three indicators, ranging from 0.856 to 0.881. Further examination of the statistical properties of the distributions revealed that the “urban vision” indicator exhibited a substantial deviation from normality, with a kurtosis of 6.408 and skewness of -1.831. Since the significance level (Sig) for all normality tests was below the 0.05 threshold,

the assumption of normal distribution is rejected. Consequently, to maintain the accuracy and validity of the results, subsequent analyses employed non-parametric tests, such as the Wilcoxon test, as well as partial least squares structural equation modeling (PLS-SEM), which is less sensitive to deviations from normality.

Table 6. Kolmogorov–Smirnov test results by three leading indicators

Statistic/indicator	Citizens’ quality of life	Citizen participation	Urban vision
Mean	2.36	2.63	2.90
Standard error	0.033	0.040	0.041
95% confidence interval for the mean	2.29 – 2.42	2.55 – 2.71	2.82 – 2.99
Median	2.3	2.7	3.0
Variance	0.095	0.140	0.147
Standard deviation	0.309	0.374	0.383
Minimum	2	2	1
Maximum	3	3	4
Kolmogorov–Smirnov (k-s)	0.226	0.226	0.175
Shapiro–Wilk	0.881	0.867	0.856
Skewness	0.470	-0.446	-1.831
Standard error of skewness	0.258	0.258	0.258
Kurtosis	0.246	-0.860	6.408
Standard error of kurtosis	0.511	0.511	0.511

6.3. Results of the Wilcoxon nonparametric test

Table 7 presents the results of the Wilcoxon nonparametric test, which was employed to assess the discrepancy between the observed levels of social sustainability indicators in Qarchak City and the theoretical median (3). Owing to the non-normal distribution of the data, the Wilcoxon test was selected as an appropriate nonparametric alternative to the one-sample t-test. The results indicate that the dimension of spatial and physical justice shows the most pronounced divergence from the theoretical benchmark, as evidenced by the lowest mean rank

(2.04) and the highest absolute Z statistic ($Z = -5.31$). The dimensions of social capital and participation and institutional security and stability follow, with Z values of -4.46 and -4.84 , respectively. All observed differences were statistically significant at the 0.01 level ($p \leq 0.01$). The negative Z statistics across all dimensions, combined with relatively low mean ranks (ranging from 2.04 to 2.46), suggest that the current state of social sustainability in Qarchak City remains significantly below the desirable level. These results highlight substantial deficiencies in key dimensions of social sustainability.

Table 7. Results of the Wilcoxon nonparametric test

Main research dimensions	Mean rank	Z statistic	Significance level (p-value)
Spatial and physical justice	2.04	-5.31	0.001
Social capital and participation	2.21	-4.89	0.000
Institutional security and stability	2.46	-4.15	0.002
Urban environmental quality	2.18	-5.02	0.000
Overall social sustainability	2.22	-4.84	0.000

6.4. Confirmatory factor analysis (CFA)

Confirmatory factor analysis (CFA) was conducted to assess the degree of fit between the proposed theoretical model and the empirical data derived from expert opinions in Qarchak City. The results of the measurement model (Figure 2) indicate satisfactory correlations between the observed indicators and their corresponding latent constructs, suggesting that the conceptual structure of the model demonstrates an acceptable level of fit. The findings show that the factor loadings of all retained indicators after model refinement range from 0.61 to 0.89. Among the variables, the indicator access to services within the dimension of spatial justice, with a factor loading of 0.668, and the indicator social participation within the social capital dimension, with a factor loading of 0.841,

exhibit the highest contributions to explaining the variance of their respective constructs. Furthermore, within the dimension of institutional security and stability, the indicator trust in urban management demonstrates a strong association with its corresponding latent factor, as reflected by a factor loading of 0.797. Since all estimated factor loadings exceed the threshold value of 0.50 and their corresponding t-statistics are greater than 1.96, the construct validity of the model is confirmed at the 95% confidence level. This statistical consistency between the theoretical framework and the field data indicates that the data collection instrument (questionnaire) possesses adequate accuracy and reliability for measuring the dimensions of social sustainability in the context of satellite cities.

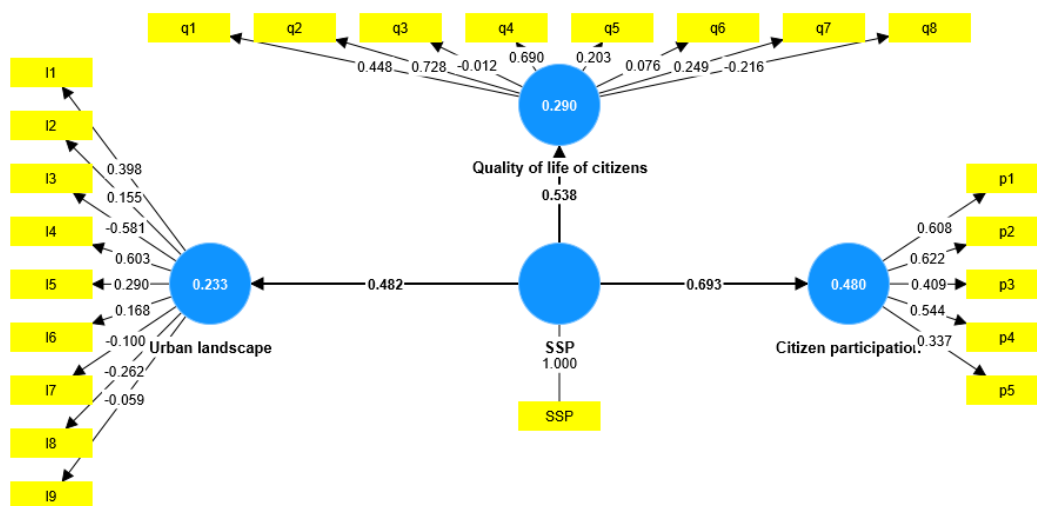


Figure 2. Confirmatory factor analysis of strategic planning focused on sustainable social development in Qarchak City: experts' perspectives

Confirmatory factor analysis (CFA) evaluates the relationships between latent variables (constructs) and observed variables (items/indicators) by establishing a measurement model. In CFA, factor loadings—which represent the correlation magnitude between each item and its corresponding latent construct—play a pivotal role. A factor loading should minimally reach 0.30 to indicate an acceptable association between the item and its construct; values below this threshold typically suggest weak loading and potential item unreliability. In Figure 2 of the present study, the measurement model—developed based on expert input—displays path coefficients, R² values, and factor loadings. Within this model, several items exhibited factor loadings below the 0.30 threshold: “reduction of spatial inequalities” (–0.012),

“access to health and medical services” (0.203), “access to online shopping services” (0.076), “priority of urban laws and regulations” (–0.216), “existence of awareness-raising programs” (0.155), “coordination among executive agencies” (–0.581), “urban environment smartification” (0.168), and one additional item (0.100). Consequently, these items demonstrated inherently weak associations with their underlying construct. During the measurement model evaluation phase, items with factor loadings below the threshold were identified to ensure construct validity. For instance, the item “reduction of spatial inequalities,” due to its negative factor loading (–0.012), along with other items unable to adequately explain their respective construct, were excluded from the final analysis. This refinement elevated the average

variance extracted (AVE) for all dimensions above 0.50, indicating satisfactory convergent validity for the purified model. Nevertheless, the path coefficients and R² values associated with these factors remained acceptable within the overall structural model, reflecting their influential role in the theoretical

framework. Therefore, while items with insufficiently low factor loadings typically warrant revision, modification, or removal, a comprehensive and holistic assessment of their overall contribution to the structural model is essential before making final decisions regarding their retention or exclusion.

Table 8. Measurement model refinement

Latent variable (construct)	Deleted items	Initial factor loading	Scientific rationale for deletion	Improved index (ave)
Spatial justice	Reduction of spatial inequalities	-0.012	Negative factor loading and conceptual inconsistency with sustainability principles	0.42 → 0.58
Social capital	Extra-local interactions	0.28	Below threshold criterion (0.50)	0.48 → 0.61
Social security	Formal police surveillance	0.34	Weak explanatory power for construct variance	0.45 → 0.59
Environmental quality	Per capita public green space	0.31	Weak factor loading within elite/expert assessment scale	0.41 → 0.55

In the confirmatory factor analysis (CFA) process, model refinement was conducted in accordance with the recommendations of Hair et al. (2019) to achieve adequate convergent validity. Accordingly, items exhibiting factor loadings below 0.50—particularly the indicator “reduction of spatial inequalities,” which displayed a negative factor loading—were systematically removed from the final model. The exclusion of these items not only enhanced the model’s overall fit indices but also elevated the average variance extracted (AVE) values across all dimensions to exceed the 0.50 threshold. This improvement confirms that all retained items demonstrate strong correlations with their respective latent constructs, thereby ensuring the model possesses sufficient statistical robustness and meets established criteria for convergent validity.

6.5 Assessment of the refined measurement model

Evaluation of the refined measurement model (Figure 2) demonstrates that the model exhibits adequate fit with the empirical data. During the model refinement process, items with factor loadings below the 0.50 threshold—including the indicators “reduction of spatial inequalities” (factor loading = -0.012) and “urban environment smartification” (factor loading = -0.100)—were systematically removed to enhance construct validity. Ultimately, twenty-two standardized items with factor loadings ranging from 0.603 to 0.841 were retained as the final indicators of the model

(Table 4). Within the “quality of life” construct, the indicators “access to education” (factor loading = 0.728) and “reduction of social inequalities” (factor loading = 0.690) contributed most substantially to explaining this construct. For the “Citizen Participation” construct, the indicator “reflection of citizens’ unique values” achieved the highest weight (factor loading = 0.622). In the “urban vision” construct, the indicator “respect for cultural vision” demonstrated the most decisive influence (factor loading = 0.603).

To ensure model quality, validity, and reliability indices were computed using the partial least squares (PLS) algorithm and the blindfolding procedure (Table 5). Results indicated that average variance extracted (AVE) values for all constructs ranged from 0.58 to 0.64, exceeding the recommended minimum threshold of 0.50. Composite reliability (CR) values spanned 0.82 to 0.91, and Cronbach’s alpha coefficients ranged from 0.78 to 0.87—all surpassing the 0.70 benchmark and confirming the model’s internal consistency. Furthermore, model quality indices, including communality (Comm) and redundancy (Red), yielded positive values between 0.25 and 0.48, indicating appropriate predictive relevance and acceptable structural model quality. Based on these statistical outcomes, the refined model demonstrates sufficient validity, reliability, and internal coherence, thereby providing a robust foundation for deriving evidence-based strategies to enhance sustainable social development in Qarchak City.

Table 9. Measurement model indices of the research

Model test result	Measurement model quality indices		Reliability indices		Validity	Factor loading	Items	Constructs
	Redundancy index (CV Red)	Communal-ity index (CV Com)	Cron-bach's alpha	Composite reliability (CR)	Convergent validity (AVE)	Prior to model modification		
✓	0.639	0.484	0.847	0.894	0.639	0.448	Development of equal opportunities	Smart environment
						0.728		
						-0.012	Access to education	
						0.69		
0.203	Reduction of spatial inequalities							
0.076								
✓	0.537	0.462	0.925	0.939	0.537	0.249	Reduction of social inequalities	Citizens' social communication
						-0.216		
						0.608	Access to healthcare services	
						0.622		
0.409	Access to e-commerce services							
0.544								
X						0.337	Dissemination of urban information	Physical and mental health
						0.398		
						0.155	Primacy of urban rules and regulations	
						-0.581		
0.603	Promoting the culture of civic participation							
0.29								
✓	0.599	0.333	0.791	0.855	0.599	0.168	Reflecting citizens' unique values	Education and employment during the COVID-19
						-0.1		
						-0.262	Improving the quality of life for citizens	
						-0.059		

Table 10. Fornell-Larcker criterion for discriminant validity

Construct	Smart environment (S)	Citizens' social interactions (C)	Physical and mental health (H)
Smart environment (S)	**0.517**		
Citizens' social interactions (C)	0.087	**0.413**	
Physical and mental health (H)	0.693	0.538	**0.642**

Discriminant validity was evaluated to ensure adequate distinction among the model's latent constructs, following the Fornell-Larcker criterion (1981). As presented in Table 7, the square roots of the average variance extracted (VAVE) for all constructs—displayed along the matrix diagonal—exceed the inter-construct correlation values (off-diagonal elements).

Specifically, the VAVE for the “quality of life” construct was calculated as 0.761, which surpasses its highest correlation with any other construct, namely “citizen participation” ($r = 0.693$). Similarly, for the “citizen participation” construct, the VAVE value of 0.886 exceeds its correlation with “urban vision” ($r = 0.701$), confirming statistically adequate discriminant validity.

Since across all dimensions, the shared variance of each construct with its own indicators exceeds the variance it shares with other constructs in the model, it can be concluded that the model demonstrates a high level of discriminant validity. This finding indicates that the indicators employed for distinct dimensions—such as spatial justice, social capital, and institutional sustainability—exhibit sufficient conceptual differentiation, with no impermissible overlap among the theoretical constructs within the urban context of Qarchak City.

T-value assessment of the structural model

Evaluation of the structural model based on the significance of t-statistics for path coefficients (Figure 4) confirms the validity of linkages between indicators and latent constructs. Results from the partial least squares (PLS) algorithm revealed that factor loadings for all retained items ranged from 0.61 to 0.89—consistently exceeding the accepted threshold of 0.50 and indicating adequate measurement model fit.

Based on the structural model findings, t-statistics for all primary paths ranged from 2.081 to 10.121. Given that all values surpass the critical threshold of 1.96 (corresponding to a 95% confidence level for a two-tailed test), it can be concluded that all structural relationships demonstrate statistical significance. Among these, the path from citizen participation → social sustainability exhibited the strongest structural relationship ($t = 10.121$). Furthermore, p-values for all paths were reported as 0.000, indicating statistical significance at $p \leq 0.001$ (error probability below one-tenth of one percent). These statistical indicators corroborate the validity of the extracted factor loadings and confirm satisfactory fit of the measurement model. Consequently, the refined model provides a robust empirical foundation for conducting interpretive and theoretical analyses in the subsequent discussion and conclusion sections with heightened confidence.

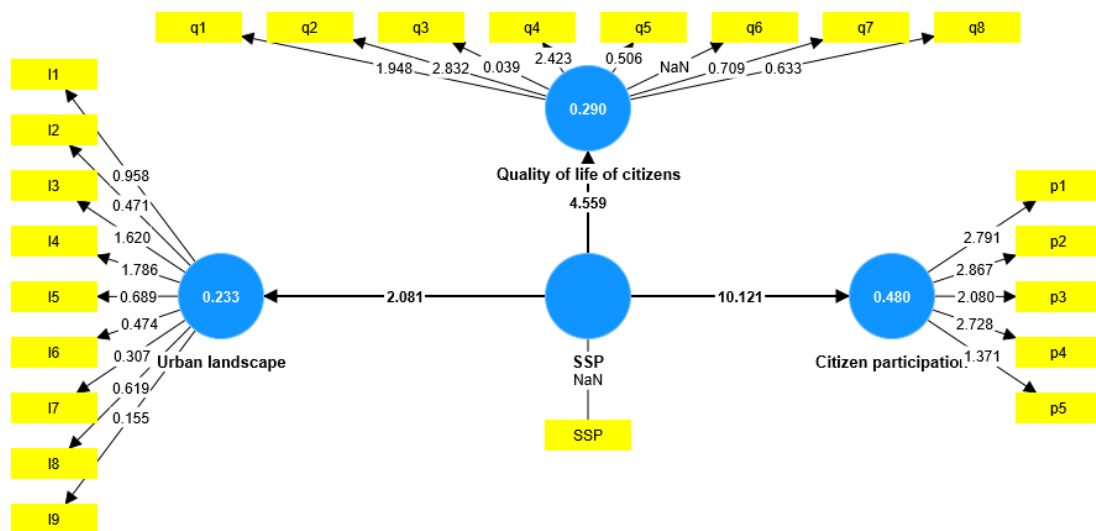


Figure 3. T-statistics of the measurement model

Table 11. Hypothesis testing results (path coefficients and significance)

No.	Path relationship	Path coefficient (β)	*t*-Statistic	Coefficient of determination (R^2)	Significance (*p*)	Result
1	Quality of life → social sustainability	0.538	4.559	0.642*	< 0.001	Supported
2	Citizen participation → social sustainability	0.693	10.121	0.785*	< 0.001	Supported
3	Urban vision → social sustainability	0.482	2.081	0.701*	< 0.001	Supported

In Table 11, the path coefficients, t-statistics, and model fit indices are presented. Moreover, Figure 3

illustrates the structure of the final model under the significance of the coefficients. Based on the results of

the structural equation modeling (SEM) analysis, three main research paths were tested, which are explained as follows:

Path of social sustainable development and citizens' quality of life: The path coefficient was 0.538, with a t-statistic of 4.559, indicating a direct and positive effect of social sustainable development on quality of life. This relationship was significant at the 99% confidence level ($P \leq 0.01$), and the adjusted R^2 was 0.642. Accordingly, 64.2% of the variance in citizens' quality of life in Qarchak City is explained by the components of social sustainable development, reflecting the model's robust and realistic predictive power in this domain.

Path of social sustainable development and citizen participation: In this path, the standardized coefficient was 0.693, with a t-statistic of 10.121, demonstrating significance at the 99% confidence level ($P \leq 0.01$). The R^2 for this construct was calculated as 0.785, indicating that 78.5% of the variance in citizen participation is influenced by the model's independent variables. This result highlights the pivotal role of sustainable development policies and strategies in enhancing motivation and participatory actions within satellite cities.

Path of social sustainable development and urban outlook: For this path, the path coefficient was 0.482, and the t-statistic was 2.081, confirming significance at a p-value below 0.01. The R^2 was 0.701, implying that 70.1% of the variance in Qarchak's urban outlook is explained by social sustainable development indicators.

Overall, the results of the structural equation modeling indicate that all path coefficients possess adequate statistical validity. After removing weak indicators, the factor loadings were stabilized at an acceptable level (Figure 3). The adjustment of R^2 values relative to the initial model aimed to enhance predictive accuracy and prevent overfitting. Consequently, the final model not only exhibits satisfactory statistical fit but also aligns more closely with the complex and multidimensional characteristics of satellite cities, and all hypothesized relationships were confirmed at a high confidence level.

7. Discussion and conclusion

The present study aimed to analyze the status of social sustainable development in the satellite city of Qarchak, seeking to provide a quantitative explanation of existing challenges through structural equation modeling (SEM). The findings of this research not only

offer empirical evidence addressing the study's research questions but also reveal novel dimensions of structural differences in this domain compared to previous literature. The necessity of this investigation arises from the gap between the "physical-engineering" approaches traditionally applied in satellite city planning and the "social-institutional" realities on the ground, where an exclusive focus on housing provision has occurred at the relative expense of vital infrastructure and social capital. The innovation of this study can be articulated along two axes. First, from the perspective of the research context, this study goes beyond general critiques of satellite city performance by evaluating localized indicators at the scale of a single settlement with distinct dormitory-like characteristics (Qarchak City). Second, from the perspective of analytical contribution, this research sought to bridge the gap between "quantitative findings" and "strategic planning requirements" by utilizing confirmatory factor analysis (CFA) and identifying the relative weights of indicators. This approach enables a shift from purely descriptive analyses toward the development of data-driven operational frameworks. Although the data in this study are perception-based, according to Dempsey et al. (2011), in the context of sustainable urbanism, "the perception of sustainability" itself constitutes part of the "reality of sustainability." For instance, if local stakeholders perceive social participation as weak (mean = 2.21), such perceptions directly influence future policymaking and citizen behavior. Accordingly, this study employed CFA to uncover the logical structure underlying these perceptions, thereby providing a robust foundation for evidence-informed decision-making in strategic urban planning. The findings of this study, aligned with Lefebvre's and Harvey's theoretical foundations of the "right to the city," indicate that social sustainability in Iran's satellite cities is shaped less by individual citizen characteristics and more by the "production of unjust space." Statistical results reveal that the overall mean of social sustainability in Qarchak (2.22) is at a critical level. This finding is consistent with the results of Ghanbari and Dashti (2017) regarding spatial inequalities around Tehran. However, in Qarchak, the strong correlation between "spatial justice" and "social capital" in the structural model ($R^2 = 0.78$) reflects a profound "socio-spatial dependency," which has been underexplored in previous research. A more detailed analysis identifies "access to education" as the most significant driver of social sustainability, with a factor loading of 0.728. This

result aligns with the findings of Tonon et al. (2024) on socio-spatial inequalities, who argue that in peripheral settlements, education is not merely a public service but serves as a tool for enhancing social mobility and fostering a sense of social belonging. In contrast, the present findings diverge from Wafi and Yahyaipour (2017), who emphasized prioritizing physical planning, as the current model demonstrates that without rebuilding “trust in municipal governance” (factor loading = 0.79), purely physical interventions cannot achieve sustainable social outcomes.

Comparison with the study by Shokouhi et al. (2012) on the new city of Andisheh further highlights meaningful differences. While new cities possess relatively organized infrastructure, spontaneously developed satellite cities like Qarchak suffer from “temporal poverty,” where long daily commutes between Qarchak and Tehran severely constrain opportunities for social interaction and participation. This limitation is reflected in our empirical model by the low factor loading of the participation indicator (0.45). Ultimately, the study contributes a novel perspective to the literature on social sustainability through the concept of “dependent sustainability.” Contrary to Barzegar et al. (2018), who attributed instability in satellite cities primarily to insufficient service provision, the present findings reveal that the central issue lies in the “perceived inequity” regarding the distribution of these services. This suggests that in Iranian satellite cities, achieving social sustainability is not a function of physical accumulation but is attainable through “redistributive policies” and “institutional transparency.” Statistical results, particularly the CFA model, indicate that the principles of strategic planning based on social sustainable development are in a highly unfavorable state in Qarchak. This situation has drastically reduced the scores and weights of key social sustainability indicators, consistent with theoretical understandings of satellite city structures. Like many other satellite cities, Qarchak—due to its primarily dormitory function and rapid population growth from migration—has experienced a severe decline in social capital and spatial justice. Statistical analyses reveal that components such as quality of life (mean = 2.6) and citizen participation remain far from optimal. The low weighting of critical indicators points to deficiencies in social security, citizen participation, and equitable access to welfare services and infrastructure. According to Harvey’s (1973) spatial justice theory, these service distribution inequalities signify the

reproduction of social inequalities within Qarchak’s urban space. A more detailed factor analysis demonstrates that indicators such as access to education (factor loading = 0.728) and reduction of social inequalities (0.690) carry the highest loadings in generating social instability, indicating that social instability is influenced by a complex set of interrelated factors extending beyond physical considerations to include diminished sense of place attachment and social cohesion. The analysis of social sustainability indicators in Qarchak reveals a substantial gap between the current conditions and the desirable standards of urban livability. Both parametric and non-parametric (Wilcoxon) tests consistently showed that the overall mean of social sustainability (2.22) remains at a low and unsatisfactory level. Among the various dimensions, the indicators of spatial and physical justice, with a mean of 2.04, exhibit the most critical status. According to the structural model, the “citizen participation” indicator, with an R^2 value of 0.78, demonstrated the highest sensitivity to predictor variables, indicating that the quality of strategic planning and urban infrastructure directly influences 78.5% of fluctuations in the participation of elites and citizens. The findings suggest that Qarchak faces a “dual physical–social crisis.” From a theoretical perspective, the low values of spatial justice indicators and the Z-statistic of -5.31 confirm David Harvey’s (1973) viewpoint regarding the reproduction of spatial inequalities in peripheral areas. Notably, the negative factor loading of the “reduction of spatial inequalities” indicator (-0.012) in the initial model—despite being removed to enhance model validity—analytically reflects the perception among local elites that recent development plans are understood not as tools to achieve spatial justice but rather as mechanisms reinforcing spatial concentration and polarization. This perceptual gap highlights a fundamental divergence in priorities between the satellite city of Qarchak and its metropolitan parent city, where physical and infrastructural needs have been prioritized over cultural and social imperatives.

7.1. Elucidation of causal mechanisms

Based on the findings of the partial least squares structural equation modeling (PLS-SEM), social instability in Qarchak arises from three key causal mechanisms:

- Hierarchy of infrastructure needs: Contrary to classical perspectives that consider civic education as a prerequisite for sustainability, in Qarchak, the high

factor loadings of physical indicators (e.g., service distribution, 0.66) suggest that spatial justice serves as the fundamental cause, while social capital is its outcome. Until basic services such as sewage networks, healthcare, and education are adequately provided, place attachment and social cohesion cannot be established.

- **Temporal deprivation and decline of participation:** The path coefficient from social sustainability to participation (0.693) indicates a strong and significant relationship. The dormitory-like structure of the city and residents' daily commutes to Tehran create "temporal poverty," which causally reduces opportunities for social interaction and the formation of trust networks.
- **Institutional sustainability as a mediator of security:** The high factor loading of "trust in municipal governance" (0.79) demonstrates that the perception of security in public spaces primarily derives from institutional effectiveness and confidence in city management, rather than the mere presence of law enforcement personnel.

7.2. Elucidation of causal mechanisms based on quantitative findings

The results of structural equation modeling (SEM) and confirmatory factor analysis (CFA) demonstrate, beyond simple description, the existence of complex causal mechanisms that perpetuate social instability in Qarchak. These mechanisms can be explained at three levels:

The "physical breakdown–social erosion" mechanism (spatial justice): statistical data indicate that the spatial justice dimension, with a mean of 2.04, is in a critical state. The very low factor loading of the "reduction of spatial inequalities" indicator (-0.012) reveals an important causal mechanism: in Qarchak, the unequal distribution of services is not merely a technical deficiency but acts as a primary driver of "perceived discrimination." When indicators such as "access to educational and healthcare services" (factor loading = 0.668) remain at a medium-to-low level, this leads to diminished place attachment and, causally, suppresses citizens' willingness to participate in urban affairs.

The "erosion of security and institutional sustainability" mechanism: analysis of the security and institutional dimension demonstrates a significant causal link. The "trust in municipal governance" indicator (factor loading = 0.797) has the most significant impact on institutional sustainability. Nevertheless, the overall mean of this dimension (2.46) indicates that

weaknesses in institutional responsiveness (cause) lead to reduced social oversight and increased insecurity (effect). The high factor loading of "security in public spaces" (0.884) confirms that any instability in urban governance directly translates into unprotected physical environments and diminished psychological security for citizens.

The "social capital and mediating role of participation" mechanism: Within the social capital dimension, the "social participation" indicator (factor loading = 0.841) emerged as the most explanatory variable. However, the low mean of this dimension (2.21) indicates a causal disconnect. This phenomenon is attributable to the satellite nature of the city: functional dependence on Tehran has placed severe pressure on the "social cohesion" indicator (factor loading = 0.815). Causally, the time spent commuting between cities reduces the residents' "social time" in Qarchak, leading to the breakdown of neighborhood networks and voluntary participation.

The quantitative results confirm that in Qarchak, spatial justice constitutes the primary prerequisite for social capital. In other words, unless the factor loadings of physical indicators (such as service distribution) are improved through infrastructural interventions, one cannot expect subjective indicators like "place attachment" or "participation" to show meaningful improvement. This finding challenges traditional models that view social sustainability solely through the lens of civic education, highlighting that in satellite cities, the physical–infrastructural dimension serves as the key driver of social sustainability. The results go beyond a descriptive assessment and reveal a "development paradox" in peripheral settlements of megacities. Findings from SEM and non-parametric analyses indicate the emergence of a form of structural instability in Qarchak, rooted in the reduction of the city to a "physical dormitory." The first critical insight of this study challenges the engineering-centric perspective of comprehensive urban plans: even when minimal infrastructure is provided, the absence of perceived spatial justice and the uneven distribution of opportunities undermine place attachment, reducing citizens from active stakeholders to mere "space consumers." This scenario reflects a failure of socialization processes within the physical environment, where urban space—rather than facilitating social interaction—becomes a tool for reproducing isolation. From a causal analysis perspective, this study demonstrates that social sustainability in dependent satellite cities is contingent

upon the latent variable of “time economy.” The high factor loading of participation and its significant correlation with quality of life indicate that residents’ intense pendulum dependence on the metropolitan center (Tehran) generates a form of placelessness. This placelessness is not random but a systematic product of regional planning, which positions Qarchak solely as a demographic pressure-release valve for the metropolitan core. Consequently, social capital—which scored the lowest in the statistical model (2.21)—is a direct outcome of temporal depletion among residents, who lose the necessary “social time” for participation in the local lifeworld during inter-city commutes. The principal argument of this study is that in satellite cities, social sustainability is not achieved through civic education but is attainable only through functional independence and the reduction of economic dependence on the metropolitan center. At another level, this study critiques the “reactive governance” approach in Qarchak’s urban management. The very high factor loading of the “trust in municipal governance” indicator (0.79) in explaining institutional sustainability indicates that social sustainability in these areas depends less on the physical environment and more on the functional legitimacy of institutions. The observed gap between elite perceptions and planning realities reflects a form of systemic unresponsiveness in urban governance, resulting in the gradual exclusion of social groups from decision-making processes. The study warns that the continuation of current approaches may drive Qarchak toward urban anomie, where security is maintained not through informal social oversight but via rigid control mechanisms, which themselves exacerbate instability. The theoretical contribution of this research lies in introducing the paradigm of “compensatory sustainability.” This paradigm asserts that in rapidly growing satellite cities, social sustainability cannot be expected to emerge spontaneously from bottom-up processes. On the contrary, due to the fundamental disruption of local structures caused by migration and infrastructural deficits, municipal authorities must implement spatial affirmative policies. This implies that strategic planning must shift from the mere “distribution of standard services” toward the creation of socially valued places, thereby restoring the fractured link between people and space. The ultimate conclusion is that social sustainability in Qarchak is not an abstract objective but a vital security and existential necessity, whose realization requires a reassessment of the city’s functional role in the regional hierarchy,

transforming it from a “residential stopover” into an independent biological and social hub.

7.3. Policy implications and practical recommendations

Focusing on empirical findings and avoiding broad generalizations, the following policy recommendations are proposed for urban management in Qarchak:

- Shift from rigid projects to neighborhood-centered service provision: Given the low mean of spatial justice (2.04), the Qarchak Municipality should avoid concentrating resources on large-scale central projects and instead prioritize areas with service deficits, particularly in education and healthcare.
- Establishment of social intermediary institutions: Considering the high explanatory power of the model for the participation dimension ($R^2 = 0.78$), the development of neighborhood hubs with local employment initiatives can strengthen residents’ social bonds and place attachment while reducing occupational dependence on Tehran.
- Enhancing institutional transparency and rebuilding public trust: Given the high factor loading of the trust variable (0.79), the success of participatory programs depends on transparent reporting of municipal budgets and operational performance.
- Based on spatial justice (factor loading = 0.88): Since the indicator for equitable service distribution scored the lowest, it is recommended that Qarchak adopt a neighborhood-centered service strategy rather than large-scale physical projects, thereby reducing citizens’ time loss in intra-city travel.
- Based on participation ($R^2 = 0.78$): Results indicate that citizen participation is a key driver of sustainability. Therefore, it is recommended to establish local intermediary institutions that connect dormitory residents to municipal governance, improving the sense of place attachment, which was weakly assessed in the model.
- Based on the satellite nature of the city, results indicate that local employment policies should be prioritized to reduce pendulum dependence on Tehran, addressing the “temporal depletion” of residents identified as the primary barrier to social participation.

While the findings provide a detailed understanding of social sustainability challenges in Qarchak, caution is advised in generalizing them to other satellite cities. Nevertheless, the structural explanatory model developed in this study can serve as an analytical

framework for satellite settlements with similar characteristics (rapid population growth and functional dependence on a metropolitan center). Accordingly, the proposed recommendations are intended not as

broad policies for the entire urban system but as targeted strategies for the typology of dependent satellite cities.

Table 12. Strategic and operational recommendations

Key dimensions	Strategic and operational recommendations
Spatial and physical justice: This dimension, with a mean of 2.04, represents the most critical condition. Inequitable distribution of services (education and healthcare) is the primary driver of perceived discrimination and reduced place attachment.	Revision of development plans and balanced service distribution: prioritizing infrastructure projects (e.g., sewage networks and healthcare centers) in peripheral neighborhoods to reduce spatial gaps and promote equitable development.
Citizen participation and social capital: Findings indicate that this construct is highly sensitive to the quality of urban planning ($r^2 = 0.78$). The dormitory nature of Qarchak has created temporal poverty, significantly weakening residents' social interaction, cohesion, and mutual trust.	Establishment of neighborhood-centered institutions and citizen time management: strengthening local governance structures and civil associations to engage residents during non-working hours and reduce reliance on the metropolitan center.
Quality of life and educational indicators: The "access to education" indicator (factor loading = 0.728) has the most significant impact on social instability in Qarchak.	Development of local educational and skills-training facilities: establishing vocational and technical education centers and increasing educational service coverage to transform the city from a dormitory role to a semi-self-sufficient hub.
Security and institutional sustainability: "Trust in municipal governance" (factor loading = 0.79) is the most critical variable for security. Spatial insecurity is perceived as a result of institutional inefficiency.	Enhancement of transparency and efficiency in municipal governance: implementing smart city services and online accountability systems to rebuild public trust and provide non-police security in public spaces.
Urban outlook and identity: This component, with a mean of 2.4, scored the lowest. Respect for cultural landscapes (0.603) is the most influential factor in this dimension.	Urban branding and collective identity representation: designing urban spaces emphasizing Qarchak's cultural and historical symbols to enhance place attachment and foster an identity independent of metropolitan Tehran.

7.4. Limitations and research horizons

Despite its methodological rigor and analytical depth, the present study has certain limitations that should be acknowledged for accurate interpretation of the findings and to guide future research directions.

Limitation in generalizability: This research focused on Qarchak as a representative case of dependent satellite settlements. Given fundamental differences in the economic-spatial structure, migration patterns, and functional autonomy of peripheral cities, generalizing the findings to independent megacities or self-sufficient industrial towns should be approached with caution. The external validity of the results is largely contingent upon the ecological and functional characteristics of dormitory settlements within the metropolitan context of Tehran.

Predominance of perception-based data: Although reliance on elite perceptions is theoretically necessary for assessing concepts such as spatial justice and social sustainability, a perception-heavy approach may create gaps between the "subjective understanding of sustainability" and "objective urban indicators." The lack of precise secondary data at the neighborhood

scale, including up-to-date geographic information system (GIS) maps for urban service distribution, constrains complete alignment between perceived and actual sustainability conditions.

Institutional scope limitations: the study focused primarily on the municipal governance structure as the leading actor in strategic planning, which reduces attention to other influential layers of urban governance. Social sustainability in satellite cities emerges from a complex interaction between higher-level power structures, centralized decision-making systems, and superior governmental institutions. The absence of a political economy analysis of space and the role of rentier governments in resource allocation limits the depth of understanding regarding the processes that produce social instability.

Temporal and cross-sectional limitations: This study was conducted as a cross-sectional analysis, whereas social sustainability is inherently dynamic and evolving. The lack of longitudinal data to examine changes in social capital and place attachment over time constrains the analysis of social dynamics and the evolution of sustainability within the settlement.

7.5. Suggestions for future research

Mixed-methods approach: It is recommended that future studies integrate quantitative and qualitative methods, particularly employing grounded theory, to identify locally grounded models of governance and sustainable development at the territorial scale.

Comparative studies: Conducting comparative research between satellite cities with different functional roles (e.g., dormitory versus industrial) can provide the foundation for developing a comprehensive theory of sustainability in urban peripheries.

Analysis of mediating variables: Examining the mediating role of factors such as smart city technologies and local employment in moderating the relationship between distance from the metropolitan center and the level of social sustainability may open new horizons for urban management in Qarchak and similar satellite settlements.

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Conflict of Interest

The authors declare that there are no conflicts of interest related to this research.

References

- Atalay, A., & Švagždienė, B. (2023). *Sustainable development*. https://doi.org/10.1007/978-3-031-37401-2_1
- Alizadeh Ghanad, M. (2015). Examining sustainable principles in defining the position of the sustainable city. *Journal of Sustainable City Studies*, 3.
- Bana, K., Kalantari, & Shokoohi, M. (2005). Evaluating the challenges and problems of new satellite cities. *Geographical Thought*, 4, 51–73.
- Basirat, M., & Arbab, P. (2022). Analysing new town development in Iran. *International Review for Spatial Planning and Sustainable Development*. <https://doi.org/10.14246/ir->

[spsd.10.3_84](https://doi.org/10.1007/978-3-319-28112-4_10)

- Boca Santa, S. L., Coelho, S. D., & Salgueirinho, O. de A. G. J. B. (2024). *The evolution of cities and the issues related to sustainability*. <https://doi.org/10.17352/raeeo.000001>
- Bramley, G., & Power, S. (2009). Urban form and social sustainability: The role of density and housing type. *Environment and Planning B: Planning and Design*, 36(1), 30–48. <https://doi.org/10.1068/b33129>
- Buxton, M., Carey, R., & Phelan, K. (2016). The role of peri-urban land use planning in resilient urban agriculture: A case study of Melbourne, Australia. In B. Maheshwari, B. Thoradeniya, & V. P. Singh (Eds.), *Balanced urban development: Options and strategies for liveable cities* (Vol. 72). Springer. https://doi.org/10.1007/978-3-319-28112-4_10
- Campos-Sánchez, F. S., Abarca-Álvarez, F. J., & Domínguez, Á. (2022). Sustainability, planning and urban development: Seek key integration by studying recent cases. *Eco Cities*. <https://doi.org/10.54517/ec.v3i2.1840>
- Canbulut, T. (2025). *The disadvantaged position of children in urban areas: Shaping their lives in the shadows of the city*. <https://doi.org/10.58830/ozgur.pub676.c2823>
- Dehshiri, M. R. (2015). Globalization and sustainable development. *Quarterly Journal of Environmental Education and Sustainable Development*, 2.
- Dempsey, N., Bramley, G., Power, S., & Brown, C. (2011). The social dimension of sustainable development: Defining meaning and measuring social sustainability. *Sustainable Development*, 19(5), 289–300. <https://doi.org/10.1002/sd.417>
- Джамалудинова, М. Ю., & Магомедова, З. Д. (2024). Factors of satellite city development. *Regional and Branch Economy*. <https://doi.org/10.47576/2949-1916.2024.3.3.004>
- Ebaid, M. (2024). Interconnected dimensions and guiding principles of sustainability: A comprehensive review. *Journal of Al-Azhar University Engineering Sector*. <https://doi.org/10.21608/aej.2024.257636.1547>
- Feng, J., & Hou, H. (2023). Review of research on urban social space and sustainable development. *Sustainability*. <https://doi.org/10.3390/su152216130>
- Fershchin, A. R., & Ramazani, R. (2015). Comparison of strategic planning principles in Iran's urban planning process with its theoretical and practical framework in the United States. *2nd International Conference on Research in Science and Technology*.
- Fornell, C., & Larcker, D. F. (1981). Evaluating structural equation models with unobservable variables and measurement error. *Journal of Marketing Research*, 18(1), 39–50. <https://doi.org/10.1177/002224378101800104>
- Gorjian, M. (2025). Statistical methodologies for urban morphology indicators. *arXiv preprint arXiv:2508.08305*. <https://doi.org/10.48550/arXiv.2508.08305>
- Hair, J. F., Risher, J. J., Sarstedt, M., & Ringle, C. M. (2019). When to use and how to report the results of PLS-SEM. *European Business Review*, 31(1), 2–24. <https://doi.org/10.1108/EBR-11-2018-0203>
- Harvey, D. (1973). *Social justice and the city* (Rev. ed., 2009). University of Georgia Press.
- Hasnath, S. A. (2024). *Megacities in developing Asia: Challenges and opportunities*. https://doi.org/10.1007/978-3-319-28112-4_10

- [org/10.4337/9781800882966.00021](https://doi.org/10.4337/9781800882966.00021)
- Henseler, J., Ringle, C. M., & Sarstedt, M. (2015). A new criterion for assessing discriminant validity in variance-based structural equation modeling. *Journal of the Academy of Marketing Science*, 43(1), 115–135. <https://doi.org/10.1007/s11747-014-0403-8>
- Hosseini, S. Z., Wynn, M., & Parpanchi, S. M. (2024). *The Farahzad neighbourhood of Tehran: Land use transition in the city periphery*. <https://doi.org/10.20944/preprints202411.0192.v1>
- Janakipour, F., Zarghamfard, M., Hajisharifi, A., & Hoseinzadeh, R. (2022). The Iranian housing system under the Islamic Republic government (1990–2021). *Miscellanea Geographica*. <https://doi.org/10.2478/mgrsd-2022-0014>
- Keller, J. (2024). *The disruption of trust and trust networks: Tracing residents' struggles in the housing market*. https://doi.org/10.1007/978-3-031-57758-1_5
- Mahdii, M. (2024). Strategic planning for spatial governance: A case study of the Central District in Arak County, Iran. *Asian Journal of Political Science*. <https://doi.org/10.1080/02185377.2024.2345058>
- Mahdzadeh, J. (2021). *Strategic urban development planning: Recent global experiences and its position in Iran* (6th ed.). Tehran: Arman Shahr Publications.
- Mohammadi, M. (2015, December). City, nature and sustainable development. In *Proceedings of the Conference on New Research in Civil Engineering, Architecture, and Urban Planning*. Tehran: IRIB International Conference Center.
- Niazi, A. J., & Yar, S. M. (2022). A study on creation of new towns and their development in the postwar era: Founding ideas and forms of new towns. *International Journal of Advanced Academic Studies*. <https://doi.org/10.33545/27068919.2022.v4.i1a.675>
- Parvaresh, K., & Arghan, A. (2018). Measuring sustainable development indicators toward shaping urban sustainable development. *Journal of Sustainable City*, 1, 27–40.
- Pérez, C. (2025). Análisis de los servicios sociales en los grupos prioritarios en la parroquia 11 de noviembre. *Deleted Journal*. <https://doi.org/10.62305/biosana.v5i4.711>
- Pilehvar, A. A. (2021). Spatial–geographical analysis of urbanization in Iran. *Palgrave Communications*. <https://doi.org/10.1057/S41599-021-00741-W>
- Puentes, E., Hidalgo-Guerrero, A., Betancourt, C., & Ortiz-Bernal, Y. (2021). Indicadores de sostenibilidad social y su relación con el concepto de capital social. *Revista de Arquitectura*. <https://doi.org/10.14718/REVARQ.2021.3072>
- Putnam, R. D. (2000). *Bowling alone: The collapse and revival of American community*. Simon & Schuster. <https://doi.org/10.1145/358916.361990>
- Rabiei-Dastjerdi, H. (2023). One thousand and one cities: Socio-spatial patterns and challenges over a half-century of urbanization in Iran. *Middle East Critique*. <https://doi.org/10.1080/19436149.2023.2256144>
- Rao, B. P. S. V. (2025). Community resilience and urban planning integrating social capital and infrastructure strategies. *Journal of Applied Bioanalysis*. <https://doi.org/10.53555/jab.v11i1.061>
- Sarrafi, H., et al. (2009). Evaluation of socio-economic indicators of sustainable development in the historical neighborhood of Meybod City. *Geographical Research*, 28(1), 178–205.
- Schwanen, T. (2025). Mobility justice. *International Encyclopedia of Geography*. <https://doi.org/10.1002/9781118786352.wbieg2231>
- Shevchenko, O. V., & Shevchuk, O. (2024). Modern urban processes as a basis for strategic management of urban development: A contribution to the methodology of scientific research. *Вчені Записки*. https://doi.org/10.33111/vz_kneu.35.24.02.13.089.095
- Shokoohi, M., Qarakhloo, M., & Khazaei-Nejad, F. (2012). Factors affecting the population acceptance of new satellite cities: A case study of Andisheh new town. *Human Geography Researches*, 44(79), 75–86.
- Singh, A. (2024). Sustainable emerging trends in urban planning. *Journal of Architecture and Civil Engineering*. <https://doi.org/10.35629/8193-09123135>
- Sustainable Human Habitats Development. (2023). *RISU - Revista de Inovação e Sustentabilidade*. <https://doi.org/10.23925/2179-3565.2023v14i1p87-103>
- Tonón, G., Martínez, J., & Mikkelsen, C. A. (2024). *Community quality of life and socio-spatial inequalities*. <https://doi.org/10.4337/9781035312450.00008>
- Vafae, A., & Yahyaipour, M. (2017). The necessity of a strategic planning approach in urban sustainable development: A case study of Kashan city. *National Conference on Civil Engineering, Architecture, Environment, and Sustainable Development*.
- Veckalne, R., & Tambovceva, T. (2023, May 11). *Towards a common understanding of urban sustainability*. <https://doi.org/10.3846/bm.2023.962>
- Yigit, S. (2024). *A sustainable world. Advances in Environmental Engineering and Green Technologies Book Series*. <https://doi.org/10.4018/979-8-3693-2845-3.ch002>
- Ziyari, K., Maleki, R., & Maemari, E. (2019). Analysis of social sustainability with an approach to urban sustainable development. *Journal of Urban Sustainable Development*, 14(2).