

The Influence of Public Green Spaces Design Characteristics on Social Cohesion in Residential Complexes in Iraq, Erbil City

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Abstract

This study explored the impact of public green space design on social cohesion in Erbil, drawing on the experiences of the cities of Mas, Ganjan, and Lana, in the context of rapid urbanization that erodes natural areas and strains community ties. The study filled a significant gap in local research by reviewing international studies demonstrating how design elements, such as accessibility, aesthetics, and functionality, can foster trust, belonging, and interaction. It also investigated how green spaces contribute to improved health and well-being by mitigating the effects of urban heat islands, pollution, and social isolation. Using an integrated research methodology, spatial audits assessed physical characteristics on a scale of 1 to 5. Additionally, 34 participants completed Likert scale questionnaires to gather their views on design and social cohesion. Pearson correlation coefficients showed statistically significant positive relationships: design and aesthetic features (such as vegetation diversity and landscaping) had the greatest impact ($r=0.543$, $p<0.001$), followed by functional amenities such as seating, lighting, and recreational spaces ($r=0.507$, $p<0.001$), while accessibility was the least important ($r=0.335$, $p<0.001$). Linear regression analysis strongly supported this hypothesis ($\beta=0.557$, $R^2=31.1\%$, $p<0.001$; $F=66.724$), with Ganjan outperforming other cities thanks to its high-quality and well-balanced green spaces. These results underscore that prioritizing user-friendly green designs over mere proximity can foster resilient communities, prompting policymakers in Erbil to integrate plant-rich designs, recreational facilities, and pedestrian accessibility into urban planning to strengthen social bonds amidst increasing population density.

Keywords — Green Space, Accessibility, Mass city, Ganjan City, Lana City.

1 Introduction

In relation to location, health, and happiness, the social environment is crucial. Although there are several definitions of social cohesiveness, a common understanding is that it is a measure of interpersonal dynamics and/or group efforts that may be used to evaluate the quality of life (Al- Kodmany, 2023). Trust, belonging, acceptance, and connectedness are all components of social cohesion that are frequently associated with positive interactions with others. These positive social norms may provide health advantages (Gao et al, 2021). Urban green spaces are designated areas in land-use plans specifically for parks and other forms of vegetation. Things like plants, water

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features (also called "blue spaces"), and other forms of nature are all part of this category. Green spaces make up the majority of urban open spaces, while other kinds of open spaces do exist. Urban open areas may have a variety of landscapes, from those that seem less planned to others that are more naturally occurring (Kisvarga et al, 2023). Green spaces are areas covered with vegetation such as grasses, shrubs, and trees, where water can permeate the soil and plants, filtering some sediments and pollutants before reaching groundwater (Abrahams et al, 2023). Green spaces and permeable surfaces are particularly important in urban areas, as they help absorb and permeate water, reducing runoff rates. This water often contains significant amounts of pollutants (Adedeji, 2023). This, in turn, reduces pressure on sewage systems and treatment plants. The high water-retention capacity of plants makes them an important element in flood mitigation and stormwater management in urban areas (Al- Kodmany, 2023).

In an era of urbanization, characterized by the rapid growth of cities worldwide, the role of urban green spaces has become critically important. These spaces, which include parks, gardens, and other natural areas within the urban landscape, are vital components in the pursuit of sustainable and healthy living (Bala et al, 2022). As the world's population increasingly migrates to urban centers, the growing demand for resources and infrastructure poses significant challenges to environmental health and human well-being (Barau et al, 2023). Urban green spaces, often referred to as "green lungs" or "urban oases," are areas within urban environments designated for vegetation, ranging from expansive public parks and community gardens to street trees. These spaces play a pivotal role in mitigating the concrete sprawl that dominates the urban landscape, adding natural areas amidst the city's bustle (De Kleyn. Et al, 2020). Urban expansion has led to an unprecedented migration of people from rural to urban areas, resulting in cities expanding and increasing their population density. While this trend contributes to economic development and innovation, it also presents numerous challenges (Dushkova, 2020). Rapid urbanization is synonymous with the proliferation of concrete buildings, a decrease in green spaces, and increased pollution levels, negatively impacting the environment and the health of city dwellers (Egerer and Buchholz, 2021)

The effects of this urban transformation are multifaceted. The shrinking of green spaces not only harms biodiversity but also contributes to a phenomenon known as the "urban heat island effect," where cities experience rising temperatures due to the absorption and retention of heat by built surfaces (Elliott et al, 2020). As the world faces the challenges of climate change, biodiversity loss, and public health crises, understanding the role of urban green spaces has become crucial (Elsadek et al, 2020). This research primarily aims to identify the key design characteristics of public green spaces and assess their impact on social cohesion. Also, the main hypotheses of this research are:

- The beneficial influence of green space design on social cohesion: Investment in neighbourhoods with well-designed public green areas encourages people to invest in the area and become friends.
- Accessibility's function in encouraging interaction: Accessibility elements like entrances, walkability, and closeness greatly boost the chances for inhabitants to engage with each other.
- Modifying and maintaining facilities is beneficial, enabling increased visitation and providing improved sitting, recreational activities, and walking areas.
- Improving the green space will foster trust among local residents, leading to increased visitation compared to a poorly maintained garden.

2 Methodology

2.1 Research Design

This study adopts an applied mixed-methods research methodology, employing a cross-sectional comparative case study approach to investigate the impact of public green space design on social cohesion in residential

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neighborhoods of Erbil City. The methodology integrates objective spatial analysis with subjective perceptual assessment, allowing for triangulation between physical design characteristics and residents' social experiences.

The objective component consisted of a structured spatial assessment in which public green spaces were evaluated using a five-point performance scale ranging from 1 (very ineffective) to 5 (very effective). This assessment focused on the physical, environmental, and functional attributes of green spaces. In parallel, the subjective component involved a structured questionnaire designed to examine residents' perceptions, satisfaction levels, and evaluations of public green spaces within their neighborhoods. The questionnaire comprised 34 items measured on a five-point Likert scale (1 = strongly disagree, 5 = strongly agree).

The results of the objective spatial assessment were systematically compared with the subjective questionnaire findings to explore correlations between green space design characteristics and perceived levels of social cohesion. This standardized and integrative research design provides a comprehensive understanding of how public green space planning influences social interaction, trust, and community relations in urban residential environments. Figure 1 illustrates the sequential stages of the applied research methodology.

2.2 Sample Collection and Study Area

Investment housing projects were selected as the study sample because they constitute the largest proportion of newly developed residential projects in Erbil and play a significant role in shaping contemporary urban living patterns. These developments are characterized by planned public green spaces and shared amenities, making them suitable for examining the relationship between green space design and social cohesion.

A purposive sampling strategy was employed to select residential complexes that differ in location, spatial configuration, scale, and proportion of green spaces, thereby enabling a comparative analysis of design inequalities and social outcomes. Based on these criteria, three major residential complexes were selected (Figure 2):

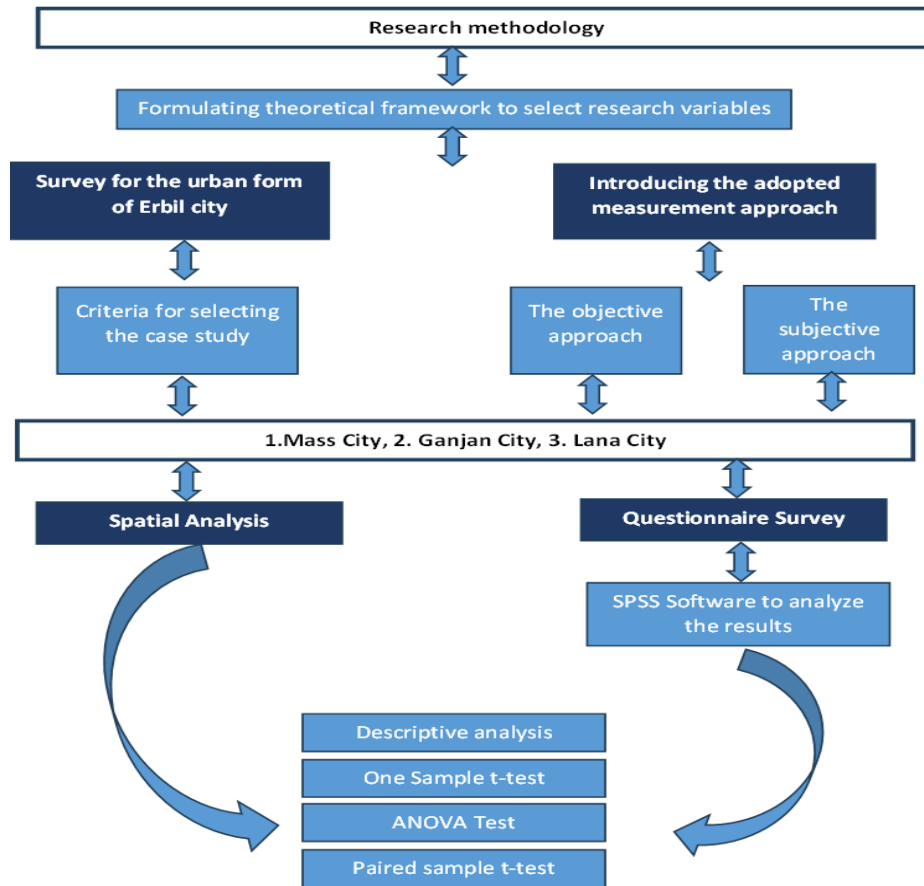


Figure 1: Methodology Diagram Structure

2.2.1 Mass City

Mass City is located between the 120-meter street and Massif Salahaddin Road and covers an area exceeding one million square meters. It comprises approximately 1,457 villas distributed across the Diamond, Jumeirah, and Palace/Village zones. The project was selected due to its large scale, diverse housing typologies, and extensive range of facilities, including schools, mosques, retail areas, clinics, gyms, sports facilities, and pet-friendly spaces. These characteristics make it an appropriate case for assessing how large, well-equipped green spaces influence social cohesion.



Figure 2: The Selected Residential Complexes

2.2.2 Ganjan City

Ganjan City is located near the junction of the 150-meter ring road and Bahrka Road. Public green and open spaces account for approximately 15–18% of the total project area. This residential complex was selected because it represents a medium-scale development with a moderate proportion of green spaces and a strong focus on community-oriented facilities such as kindergartens, small retail shops, a school, and a central mosque. These features provide an opportunity to examine how neighborhood-scale green spaces support everyday social interactions.

2.2.3 Lana City

Lana City is situated along Kasnazan Road, directly off the 120-meter road, and occupies an estimated area of 85 hectares. Residential plot sizes range from 150 to 400 m², with approximately 20% of the total area allocated to public green spaces. This case was selected due to its high percentage of green space integration and its emphasis on walkable access to essential services, including schools, shopping areas, and medical facilities. Lana City offers a contrasting spatial model for evaluating the role of green spaces in enhancing livability and social cohesion.

2.3 Data Collection Methods

Data were collected using a combination of objective spatial analysis and a questionnaire survey. For the objective assessment, a structured checklist was developed based on international literature and local urban housing standards. Public green spaces were evaluated according to seven criteria: accessibility, design and aesthetic features, functional features, usage patterns, sense of belonging, social trust, and interaction frequency. Each criterion was assessed using a five-point scale reflecting performance levels. Spatial accuracy and consistency were ensured through field observations, satellite imagery, and spatial analysis tools such as ArcGIS and AutoCAD. In parallel, residents of the selected residential complexes were surveyed using a structured questionnaire to assess their perceptions of public green spaces and their influence on social cohesion. Data were collected through in-person interviews to enhance response accuracy and reliability. The study sample consisted of 34 valid questionnaires, with an equal number of respondents drawn from each residential complex. This balanced distribution was adopted to ensure comparability across the case studies and to minimize sampling bias.



Figure 3. General layout and distribution of public green spaces within the selected residential complexes.

2.4 Data Analysis

Quantitative data analysis was conducted using IBM SPSS Statistics (Version 26). Descriptive statistics were employed to summarize respondents' socio-demographic characteristics and overall perception trends. One-sample t-tests were used to compare mean perception scores against the neutral midpoint of the Likert scale, while one-way analysis of variance (ANOVA) was applied to identify statistically significant differences among the selected residential complexes. Additionally, paired-sample t-tests were performed to examine the relationship between outcomes derived from the objective spatial analysis and those obtained from the subjective questionnaire survey, thereby supporting the validation and interpretation of the results.

3 Result and Discussion

3.1 Reliability and Data Suitability

To assess the internal consistency and reliability of the measurement scales used in this study, Cronbach's Alpha coefficient was calculated for each construct, as presented in Table 3.1. The Public Green Spaces Design scale, consisting of 13 items, achieved a Cronbach's Alpha value of 0.832, indicating excellent internal consistency among its indicators. The Social Cohesion scale, also composed of 13 items, recorded a Cronbach's Alpha value of 0.674, which is considered acceptable for perception-based social research. When all 26 items were combined, the overall scale yielded a high reliability coefficient of 0.859, confirming the robustness of the measurement instrument.

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In addition to reliability testing, data normality was examined using the Kolmogorov–Smirnov test. The results indicated that both constructs followed a normal distribution ($p > 0.05$), thereby justifying the use of parametric statistical analyses in subsequent stages of the study.

Overall, the reliability results demonstrate that the adopted measurement framework is methodologically sound and suitable for examining the relationship between public green space design and social cohesion. The relatively lower but acceptable reliability value of the social cohesion scale is consistent with findings from previous urban and social studies, where perception-based constructs often yield moderate Cronbach’s Alpha coefficients due to the complexity and subjectivity of social phenomena.

Table 3.1 Reliability analysis of study variables using Cronbach’s Alpha coefficients

Construct	Cronbach’s Alpha	Number of Items	Interpretation
1-Public Green Spaces Design	0.832	13	Excellent internal consistency
2-Social Cohesion	0.674	13	Acceptable
Total Scale (All Items)	0.859	26	Highly reliable

3.2 Descriptive Evaluation of Public Green Space Design and Social Cohesion

Following data entry and validation, descriptive statistical analysis was conducted as the first analytical stage to summarize residents’ perceptions of public green space design and social cohesion across the selected residential complexes. Mean values, standard deviations, and agreement percentages were calculated for each construct based on responses obtained through the structured questionnaire using a five-point Likert scale. The purpose of this stage was to establish a baseline understanding of overall perception trends before proceeding to inferential analyses.

As presented in Table 2, residents expressed generally positive perceptions of public green space design. Among the evaluated dimensions, design and aesthetic features achieved the highest mean score ($M = 4.11$, $SD = 0.90$), reflecting strong appreciation for visual quality, landscape diversity, environmental comfort, and overall spatial attractiveness. Functional features also received favorable evaluations ($M = 3.71$, $SD = 0.88$), indicating satisfaction with amenities such as seating areas, lighting, and recreational facilities.

In contrast, accessibility recorded a moderate mean score ($M = 3.53$, $SD = 0.90$), suggesting that although green spaces are generally reachable, certain physical or spatial barriers may still limit ease of access for some residents.

With regard to social cohesion, the overall mean score ($M = 3.67$, $SD = 0.81$) indicates a moderately positive social environment within the studied neighborhoods. Higher scores were observed for indicators related to social trust and sense of belonging, whereas interaction frequency recorded comparatively lower values, revealing that residents may feel comfortable and emotionally attached to green spaces without engaging in frequent social interactions. This finding highlights an important distinction between perceived social comfort and actual social behavior, suggesting that high environmental quality alone does not automatically foster active social engagement.

Table 2: Descriptive Statistics of Public Green Space Design and Social Cohesion

Construct	Mean	Standard Deviation (SD)	% Agreement*
Accessibility	3.53	0.90	70.5%
Design & Aesthetic Features	4.11	0.90	75.1%
Functional Features	3.71	0.88	74.1%
Social Cohesion	3.67	0.81	70.0%

*% Agreement is calculated based on responses “Agree” or “Strongly Agree.”

4.3 Relationship Between Public Green Space Design and Social Cohesion

After establishing overall perception patterns, Pearson correlation analysis was conducted as the second analytical stage to examine the relationships between public green space design dimensions and social cohesion. Composite scores for each design dimension were computed by averaging their respective questionnaire items, and these scores were then correlated with the overall social cohesion index.

The correlation results, summarized in Table 3, reveal statistically significant positive relationships between all green space design dimensions and social cohesion ($p < 0.001$). Design and aesthetic features demonstrated the strongest correlation with social cohesion ($r = 0.543$), indicating that visually appealing and experientially comfortable environments play a critical role in fostering emotional attachment, trust, and perceived social harmony among residents.

Functional features also exhibited a strong positive association ($r = 0.507$), emphasizing the importance of facilities that support everyday use and informal social encounters. Accessibility, while still significant, showed a comparatively weaker relationship ($r = 0.335$), suggesting that ease of access alone is insufficient to generate strong social cohesion without supportive design quality and functional amenities.

These findings demonstrate a multi-scale relationship between physical design attributes and social outcomes, where experiential and functional qualities exert a stronger influence on social cohesion than purely spatial proximity.

Table 3 :Pearson Correlation Between Green Space Design Dimensions and Social Cohesion

Design Dimension	Social Cohesion (r)	Significance (p-value)
Accessibility	0.335	<0.001
Design & Aesthetic Features	0.543	<0.001
Functional Features	0.507	<0.001

3.4 Predictive Effect of Public Green Space Design on Social Cohesion

Building upon the correlation analysis, linear regression analysis was employed as the third analytical stage to assess the predictive capacity of public green space design on social cohesion. A composite index of public green space design was entered as the independent variable, while social cohesion served as the dependent variable.

As shown in Table 4, the regression model was statistically significant ($F = 66.724$, $p < 0.001$). Public green space design emerged as a strong predictor of social cohesion ($\beta = 0.557$), explaining 31.1% of the variance in social cohesion levels ($R^2 = 0.311$). This result indicates a moderate to strong effect size, confirming that improvements in the overall quality of green space design are likely to result in meaningful increases in neighborhood social cohesion.

The regression findings provide empirical evidence that public green spaces function as social infrastructure, extending beyond their aesthetic and environmental roles. Well-designed green environments actively contribute to strengthening social trust, enhancing feelings of belonging, and supporting social connectedness within residential neighborhoods.

Table 4: Linear Regression Predicting Social Cohesion from Public Green Space Design

Independent Variable	B (Unstandardized)	β (Standardized)	t	p	R ²	F (ANOVA)
Public Green Spaces Design	0.421	0.557	8.168	<0.001	0.311	66.724

4 Discussion

In this study, we find that public green space design is a strong predictor of social cohesion, with reliability scales showing high values (Public Green Spaces Design $\alpha = 0.832$; Social Cohesion $\alpha = 0.674$; total $\alpha = 0.859$). The descriptive statistics show that there are aesthetic strengths, with a mean score of 4.11 and a standard deviation of 0.90. The correlations for aesthetics reach a peak at $r = 0.543$, and regression accounts for 31.1% of the variance. These results are similar to similar urban research, but they highlight the importance of context-specific perceptual-use dynamics. The results of the reliability test confirm that the measurement is appropriate, since the design scale has an excellent $\alpha = 0.832$, which is in perfect agreement with the Barcelona green space quality dimensions described by Knobel et al. (2021) (amenities/aesthetics $\alpha > 0.7$, overall good-to-excellent reliability across 149 spaces).

Similar to how de Vries et al. (2024) found $\alpha = 0.76$ for social cohesion (5-point Likert on trust/belonging) and $\alpha = 0.80$ for attachment in Dutch samples, which reflects perceptual subjectivity in urban cohesion constructs, the Social Cohesion scale's acceptable $\alpha = 0.674$ matches moderate values in neighbourhood studies. Similar to their strong psychometrics that support latent green quality measures, Knobel et al. demonstrate parametric validity post-Kolmogorov-Smirnov normalcy ($p > 0.05$) by finding that the whole scale's high $\alpha = 0.859$ surpasses access dimension alphas (0.59).

Positive impressions are moderated by interaction gaps in descriptive evaluations. Design/aesthetics ranks highest at $M = 4.11$ (75.1% agreement), which is similar to the attribute ratings of urban green spaces (UGS) in Law et al. (2023), where "natural scenery," "spatial design," and "eco-friendly practice" averaged 4.0-4.1 on similar Likert scales across user clusters, highlighting the aesthetic appeal of public parks. Despite trust/belonging highs ($M = 4.02/3.93$) and functional features ($M = 3.71$, 74.1% agreement) aligning with "eclectic users" high utility/green scores (4.3-4.6) and pragmatic clusters (3.9-4.3), this study's overall cohesion ($M = 3.67$, 70.0% agreement) and low interaction ($M = 3.06$) reflect lower wildlife/utility perceptions (2.9-3.3 in ecological users). According to studies conducted in Ireland, regular visitors to open spaces reported favourable averages ($\sim 3.5-4.0$), whereas low-exposure groups indicated insufficiency rates of up to 28%. The design-cohesion linkages are well supported by Pearson correlations (all $p < 0.001$), while the aesthetics $r = 0.543$ relationship is the strongest. This is similar to the green space usage-cohesion link in Jos, Nigeria ($r = 0.45$, $p < 0.01$), where trust and interactions were enhanced by repeated visits.

In sensitivity analyses, experience factors are given more weight than simple access, as seen in functionals ($r = 0.507$) and accessibility ($r = 0.335$), which are similar to the relationships found between greenness and social cohesiveness in Cardinali et al. (2024) (positive patterns, β up to 0.745 at 700-900m proximity, significant from 900-1500m). Similar to plant density-social cohesion plateaus, these modest r values (0.3-0.6 range) are consistent with ecological Pearson norms for linear environmental-social relationships, which further supports the importance of aesthetics.

5 Conclusion and Recommendations

This study, conducted in the cities of Mas, Ganjan, and Lana through spatial analysis and citizen surveys, demonstrated that the design of public green spaces significantly enhances social cohesion in the investment neighborhoods of Erbil. Ganjan outperformed Mas and significantly outperformed Lana in terms of accessibility, functionality, and design quality. Survey results showed that aesthetics was the most important factor ($r=0.543$, $p<0.001$; $R^2=29.4\%$), followed by functional elements such as seating and lighting ($r=0.507$, $p<0.001$; $R^2=25.7\%$), while accessibility was the least important ($r=0.335$, $p<0.001$; $R^2=11.2\%$). Ganjan's balanced strengths were clearly evident across all criteria, indicating that high-quality, easily accessible green spaces help people feel a sense of belonging and connect with others. To build strong communities, policymakers should focus on designs that include

ample green spaces, recreational facilities, and improved accessibility to services in cities. This would help Erbil grow in tandem with its increasing population.

In future work, it is recommended to consider the following suggestions:

- Prioritize design quality over mere proximity
- Enhance functional amenities to stimulate social interaction
- Integrate green spaces as social infrastructure in residential planning

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