Urban Green Space Accessibility and Residents' Perceptions: A Spatial and Survey-Based Assessment of Sargodha, Pakistan

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ABSTRACT: Urban green spaces support urban sustainability and contribute the residents' well-being, but their advantages shaped by how residents perceive and use them, instead of physical availability alone. Evidence on this distinction remains scarce for medium-sized cities in Pakistan. This study examines residents' perceptions of environmental quality, attitudes, motivation, satisfaction, and utilization of urban green spaces in Sargodha City, and situates these perceptions within the city's vegetation cover and population distribution. A structured questionnaire using five-point Likert items was administered to 110 respondents selected through stratified random sampling. A 2026 Normalized Difference Vegetation Index (NDVI) map derived from Landsat 9 OLI/TIRS imagery and the WorldPop 2026 gridded population dataset were used to characterize vegetation cover and to estimate the population living within 0 to 250 m, 250 to 500 m, 500 to 1000 m, and beyond 1000 m of urban green spaces. Data were analyzed using descriptive statistics and reliability testing. Residents held strongly positive attitudes toward urban green spaces (M = 4.075) and reported high motivation to visit them (M = 3.566), whereas perceived environmental quality (M = 2.945), satisfaction (M = 2.919), and utilization (M = 2.914) remained moderate. Vegetation was unevenly distributed across the city, yet approximately 662,000 residents, about 84% of the estimated population, live within 1000 m of an urban green space and 179,673 within 250 m. Proximity therefore appears not to be the principal constraint on use in Sargodha; shortcomings in quality, facilities, and management are. The findings support quality-led and equitably distributed green infrastructure planning in medium-sized Pakistani cities.

KEYWORDS: Urban Green Spaces, Spatial Accessibility, Residents' Perceptions, Green Space Utilization, Normalized Difference Vegetation Index (NDVI)

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Introduction

Rapid urbanization has emerged as one of the distinctive characteristics of the contemporary era. According to the United Nations, currently over 55% of the world's population lives in urban areas, and this proportion is expected to rise to approximately 68% by 2050 (Jain, 2021). Although urbanization leads to social development and economic

growth, it instantaneously creates environmental constraints, including land-use change, air pollution, increasing temperatures, urban sprawl, environmental degradation, and the loss of natural and green areas (Anser et al., 2025). These constraints are more pronounced in developing countries where rapid urbanization is often experienced, resulting in the loss of urban green infrastructure.

Green spaces are defined as areas with generally soft or natural surfaces like trees, shrubs, grass, and soil (Jin et al., 2026). Urban Green Spaces (UGS) can exist in various forms, including gardens, playgrounds, parks, green residential areas, sports fields, recreational open spaces, wetlands, and urban farms (Dmitrović et al., 2025) have been widely recognized as integral components of sustainable urban development (Aram et al., 2019).

These spaces play a significant role in human well-being and environmental quality and also offer numerous ecosystem services (Wolch et al., 2014). Green spaces help to moderate the urban microclimates (Liu & Zhang, 2025) through shading and evapotranspiration, thus mitigating thermal discomfort and the effects of the urban heat island in cities (Zhang et al., 2025). These spaces also contribute to flood mitigation (Rahman et al., 2025), air purification, carbon sequestration, biodiversity conservation, ecological resilience to climate change (Wolch et al., 2014), and reducing noise (Hanif et al., 2024; Veckalne et al., 2025). Therefore, urban green spaces are gradually regarded as integral urban infrastructure required for promoting resilient and sustainable cities (Ashinze et al., 2024).

. Apart from environmental benefits, urban green spaces provide significant social, physical (Kabisch et al., 2015), and psychological benefits (Jabbar et al., 2024). Accumulative evidence indicates that interaction with natural environments reduces morbidity, mortality, and risk of cardiovascular disease (Gascon et al., 2016), improves self-perceived health, and overall quality of life (Wang et al., 2025). Green spaces promote physical activities such as jogging, cycling, biking, walking, and recreational engagement, leading to better physical health outcomes (Han, 2017).

Urban green spaces also play a crucial role in strengthening the identity of the community and promoting social interaction. Previous studies have found that regular use of green spaces can minimize physiological distress, improve community well-being, promote social cohesion, and overall life satisfaction (Delgado-Serrano et al., 2024). Thus, urban green spaces contribute not merely to environmental resilience but also to social sustainability by improving the quality of urban life and refining social cohesion (Ostoić et al., 2025).

However, all the benefits derived from urban green spaces are not entirely dependent on their availability or physical presence. Perception of Residents regarding quality, accessibility, attractiveness, cleanliness, safety, management, and facilities significantly influences the effectiveness and utilization of these spaces (Wong et al., 2024; Veckalne et al., 2025).

Public perceptions play a significant role in determining how frequently individuals visit the urban green spaces, the various activities they engage in, and their general satisfaction level with the urban environment (Yang & Tang, 2025).

Positive perceptions of urban green spaces have been identified to boost physical activity, improve perceived urban quality of life, and better mental well-being (Giannico et al., 2021; Jabbar et al., 2024). Therefore, understanding the perception of residents has become gradually critical for evolving sustainable and inclusive strategies in urban planning.

Accessibility is another recognized element in shaping the urban green space utilization. Several studies have stated that the pattern of visitation is significantly influenced by proximity to green spaces, with the frequency of visits mostly declining as distance increases (Shu et al., 2024; Luo et al., 2026).

Several planning policies thus highlight the importance of ensuring access to green spaces within walking distance from residential areas. However, accessibility alone is not sufficient to ensure utilization, as subjective evaluations of residents concerning availability, safety, quality, social activities, attractiveness, and recreational and auxiliary facilities also influence their decision to visit the urban green spaces (Zhang et al., 2021). Therefore, both physical and perceptual dimensions must be considered to develop a holistic understanding between urban green spaces and public interactions.

Despite the growing recognition of urban green spaces and their related benefits, several important research gaps still exist. First, most existing studies have focused on developed countries and large metropolitan cities, while medium-sized cities have gained relatively less attention (Delgado-Serrano et al., 2024). Second, previous research has mainly concentrated on spatial and environmental dimensions of urban green spaces, such as ecosystem services, land-use changes, and accessibility, while relatively limited attention has been given to perceptions, utilization patterns, and satisfaction of residents. Third, studies conducted in Pakistan have primarily highlighted the physical characteristics and spatial accessibility of urban open spaces, whereas empirical studies examining perceptions of public spaces concentrated on major metropolitan cities such as Islamabad, Rawalpindi, and Lahore, whereas evidence from medium-sized cities such as Sargodha remains scarce (Zainab et al., 2023; Hanif et al., 2024).

Understanding perceptions of residents is mainly significant in Pakistan, where accelerated urbanization has led to inadequate distribution and accessibility of urban green spaces, particularly within the low-income group (Das, 2025).

Public perceptions provide a deeper understanding of deficiencies in the infrastructure of urban green spaces and promote equitable urban planning policies. However, factual evidence about the perceptions of residents and utilization of urban green spaces, particularly in medium-sized Pakistani cities, remains limited.

In addition to the questionnaire survey, updated NDVI data and population distribution derived from the WorldPop dataset were used to provide environmental and spatial context for interpreting residents' perceptions of urban green spaces.

Therefore, the main objectives of this study are as follows:

1. To examine residents' perceptions regarding the environmental quality, importance, and overall condition of urban green spaces in Sargodha City.
2. To assess residents' attitudes, motivation, satisfaction, and utilization patterns of urban green spaces and discuss their implications for sustainable urban green infrastructure planning and management.

The aim of this study is to contribute to the emerging literature on urban green spaces by generating empirical evidence to support people-centered and sustainable urban green infrastructure planning in medium-sized cities.

Conceptual Framework

Urban green spaces are gradually recognized as essential components of sustainable urban development because of their recreational, environmental, and social benefits. However, the level at which these benefits are generally experienced depends on how residents perceive, value, and actually utilize such spaces. Earlier studies have shown that interactions of residents with urban green spaces are determined by several interrelated factors, such as perceptions of environmental quality, attitudes toward green spaces, motivation for visitation, and satisfaction and utilization with existing green infrastructure (Nasution & Zahrah, 2014; Giannico et al., 2021). Consequently, understanding these relationships is significant for developing community-centered and effective policies about urban green infrastructure.

Perceived environmental quality is one of the most important dimensions influencing residents' experiences with urban green spaces. Environmental quality commonly refers to residents' assessments of the condition and benefits of green spaces, including their involvement, temperature regulation, air quality improvement, biodiversity conservation, aesthetic enhancement, and overall environmental quality. Prior Studies have found that individuals are likely to value and utilize green spaces more positively when they perceive them as attractive, environmentally beneficial, and clean (Hanif et al., 2023). On the other hand, degraded green spaces or those poorly maintained may reduce residents' appreciation and discourage their use.

Attitudes of residents toward urban green spaces also constitute an important factor in shaping their perception and behaviors. Attitudes reflect beliefs of individuals and appraisals regarding the benefits and importance of green spaces within urban environments. Positive attitudes may encourage residents to support conservation initiatives of green spaces and encourage them to utilize these spaces for social and recreational purposes. Previous studies have proved that individuals who perceive green spaces as crucial for quality of life and environmental sustainability usually reflect more favorable attitudes toward their development and preservation (Giannico et al., 2021).

Motivation is also another major factor affecting the utilization of urban green spaces. Residents may utilize these green areas and neighboring parks for several purposes, particularly interacting with nature, recreation, relaxation, physical activities, and social engagement. Motivation significantly influences the frequency of usage (Vujcic et al., 2019). Participants who reported higher motivations tend to visit green spaces more frequently and derive more benefits from these spaces.

Satisfaction level depends on the resident's expectations and experiences about the quality and availability of urban green spaces. It may vary depending on several factors including environmental cleanliness, maintenance quality, services, visual appeal, and security. Past studies have shown that Poor maintenance and inadequate facilities negatively affect the satisfaction of residents and may discourage visitation frequency (Nasution & Zahrah, 2014). In comparison, pleasant and properly managed green spaces support the overall experiences of users and increase regular visits.

Urban green space utilization reflects the residents' usage behavior influenced by a combination of perceptions and evaluation. Utilization refers to the frequency and level at which residents engage in and visit green spaces. Current literature recommends that utilization patterns are significantly influenced by perceptions of environmental quality, attitudes, motivation, and satisfaction (Vujcic et al., 2019). Residents who recognize urban green spaces positively and experience higher levels of satisfaction are comparatively more likely to use such spaces frequently.

Based on these theoretical considerations, the current study proposes that perceptions of residents concerning environmental quality determine their attitudes, motivation, and satisfaction, which later shape their utilization patterns of urban green spaces. Whereas the primary emphasis of the study is on perceptions of residents obtained through a questionnaire survey, updated Normalized Difference Vegetation Index (NDVI) data and population distribution derived from the WorldPop dataset were integrated to provide spatial and environmental context for interpreting the survey findings. Therefore, this study adopts a socio-human approach to observe perceptions of residents and utilization of urban green spaces in Sargodha City to offer empirical evidence that potentially supports community-centered and sustainable urban green infrastructure planning in medium-sized cities of Pakistan.

Materials and Methods

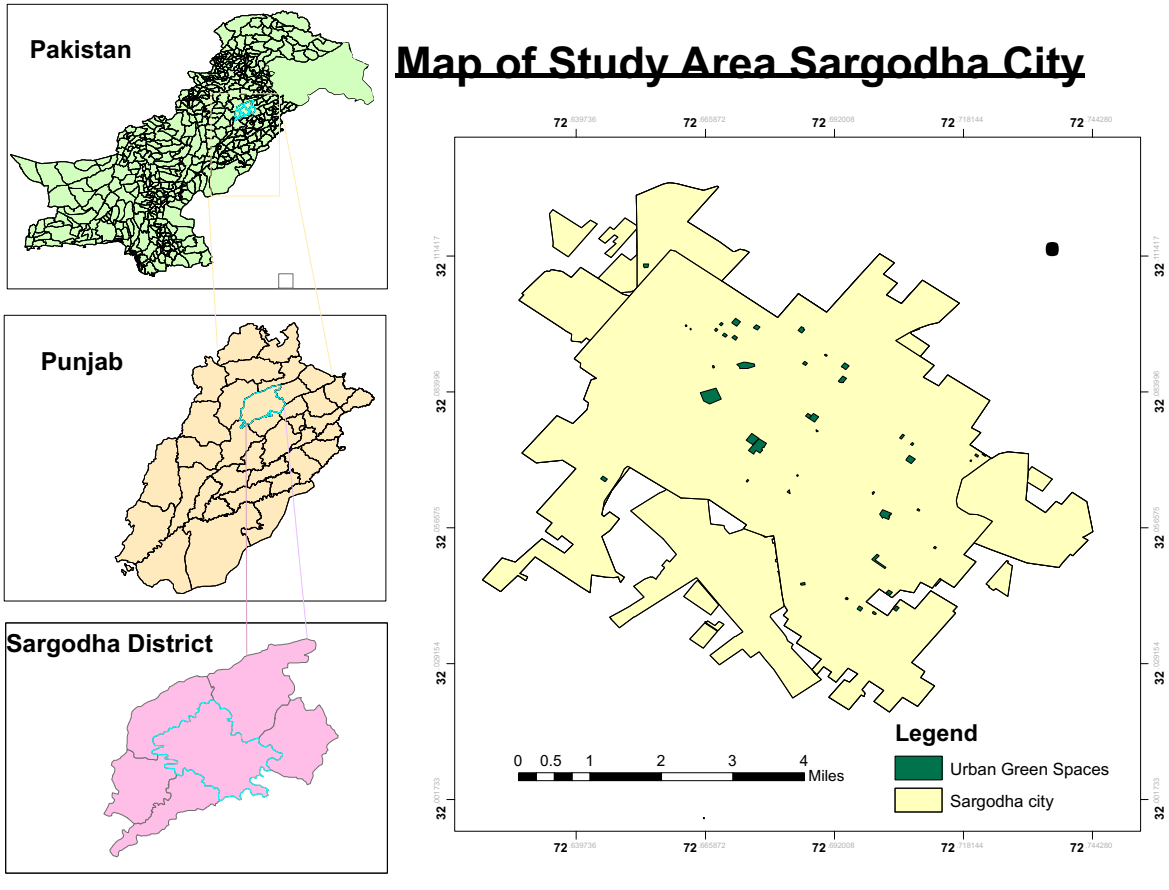
Study Area

Sargodha City (known as the City of Eagles) is one of the rapidly urbanizing cities of Punjab, Pakistan. It is located between 72°10′ and 73°18′ E and 31°34 ′ to 32°36′ N and covers a land area of nearly 5854 square kilometers (Jat

Baloch et al., 2022). Sargodha city is primarily located on a flat surface at an elevation of 190 meters. According to the census of 2017 (GOP, 2017), approximately 23.55% of the population is situated within the urban area. The fertile plains with citrus/ orange trees are located in its surroundings. It is important because of its geographical location in the northwest of the River Jhelum and the eastern side of the River Chenab. It is a hub for industrial and agricultural activities (Mushtaq et al., 2020). The climate of Sargodha city is characterized by hot and cold temperatures: in winter, sometimes it may drop to the freezing point, while in summer it reaches up to 50°C (Sajjad et al., 2015). Rainfall is concentrated in the monsoon months and has shown rising magnitude alongside an increasingly complex and anomalous spatial pattern over recent decades, indicating local exposure to climate change(Mobeen et al., 2017). By population, Sargodha city is the 11th largest city of Pakistan and the 7th largest city of the Punjab province (Ashraf et al., 2022). The population of the city has undergone substantial growth, leading to a decrease in natural vegetation and an increase in infrastructure development within urban areas. Despite the significant environmental and social benefits of urban green spaces, their quality and distribution differ among different areas of the city. Sargodha characterizes an appropriate case study as it has experienced rapid urban growth; medium-sized Pakistani cities remain relatively underexplored regarding perceptions of residents and utilization of urban green spaces. Analyzing these determinants can offer critical understanding that strengthens the conversion and equity of urban green infrastructure strategies.

Figure 1

Location of the Study Area and Urban Green Spaces in Sargodha City



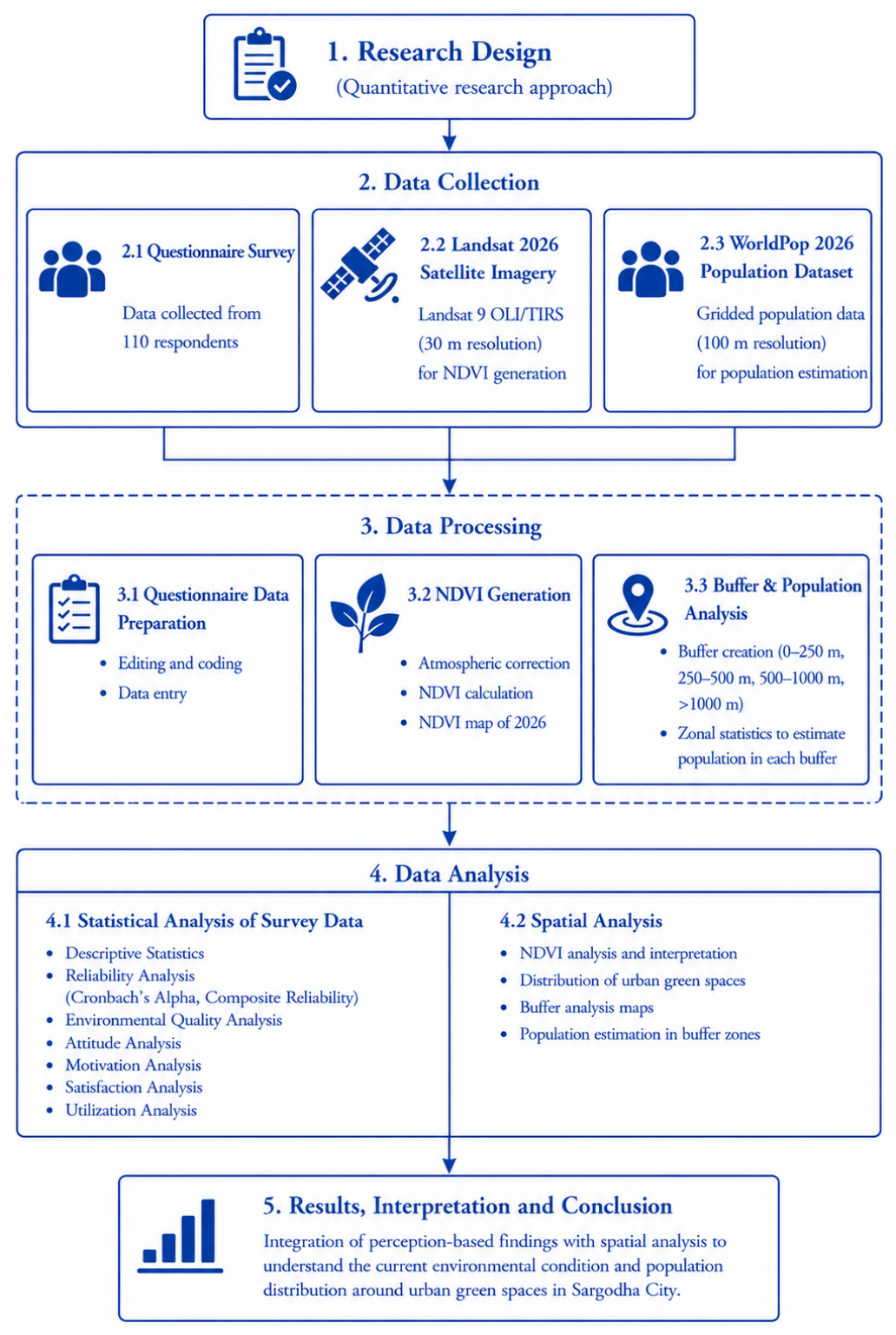
Research Design

This study adopted a quantitative research design to assess the perceptions of residents and utilization of urban green spaces in Sargodha City, Pakistan. To collect primary data from residents in the study area, a survey-based

questionnaire was used. This quantitative approach was considered more suitable as it enables structured evaluation of residents' perception, environmental quality, attitude, motivation, and satisfaction with green infrastructure alongside the usage pattern. It also permits statistical analysis of the interconnections between these factors. The flowchart adopted in this study is shown in Figure 2.

Figure 2

Methodological Flowchart



Questionnaire Development and Pilot Survey

Several items derived from well-known constructs and tools on residents' perception and urban green spaces observed in previous studies were incorporated in this survey questionnaire (Zhang et al., 2021; Delgado-Serrano et al., 2024; Veckalne et al., 2025). To align with the context of the study area and research objectives, slight modifications were made to the structure and wording of the questions. Before proceeding with the main survey, a pilot survey was conducted to assess the clarity and reliability of the questionnaire items.

Questionnaire Survey

A structured questionnaire survey was used to gather the primary data from residents of Sargodha city. The survey questionnaire covered socio-demographic information of respondents and items related to environmental quality, attitude, satisfaction, motivation, and utilization patterns toward urban green spaces. A total of 110 respondents from the study area participated in the survey.

Figure 3

Spatial Distribution of Survey Respondents in Sargodha City

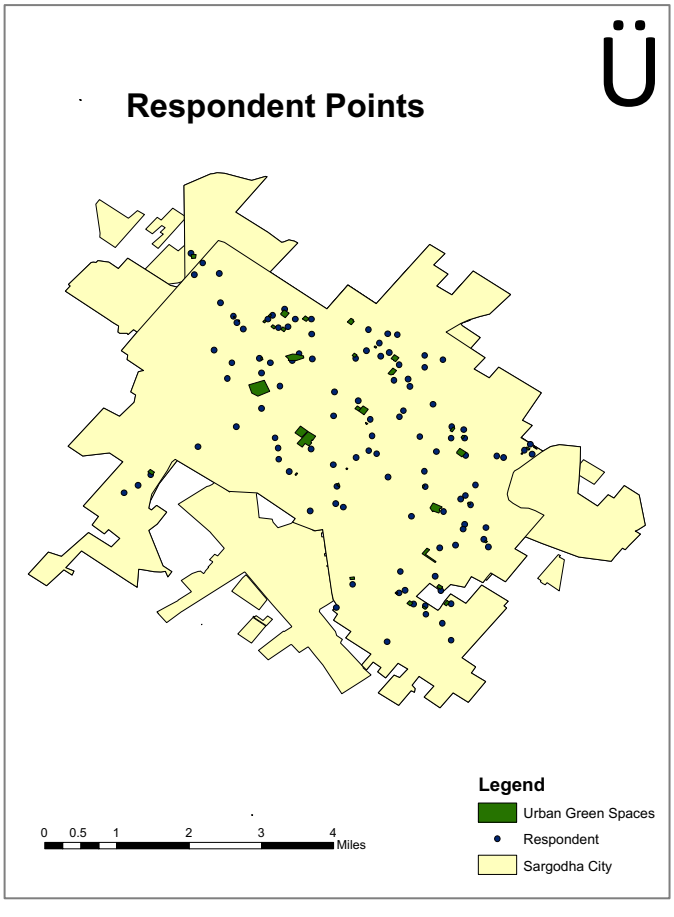


Figure 3 illustrates how respondents of the survey are distributed across Sargodha City, showing that participants were selected from various neighborhoods of the study area. To maintain a representative sample from the various residential areas of Sargodha City, a stratified random sampling method was utilized. The main aim of this approach was to gather perceptions and different experiences about urban green spaces. Perception items were assessed by using a five-point Likert scale, ranging from 1 (strongly disagree) to 5 (strongly agree), with a neutral midpoint. This scale efficiently measures the extent of agreement of respondents with each statement of the questionnaire (Robinson, 2014) and has been adopted consistently in our earlier survey research work conducted in Pakistan (Mobeen et al., 2026).

Spatial Data Processing

In addition to the survey evaluation, spatial data processing was carried out to offer a geographical background and environmental conditions to understand how residents observe urban green spaces. NDVI (Normalized Difference Vegetation Index) map for 2026 was generated using Landsat 9 OLI/TIRS imagery, emphasizing the current vegetation distribution in Sargodha City. This NDVI 2026 map was used as complementary data about the environment for the research. Additionally, the WorldPop 2026 gridded population dataset, with a spatial resolution of 100m, was integrated with the margins of urban green spaces to evaluate the population residing within different proximity zones. Buffer zones of 0–250 m, 250–500 m, 500–1000 m, and beyond 1000 m were created in QGIS. Zonal statistics were then applied to estimate the population within each buffer zone. These spatial analyses were adopted to provide population context and objective environmental data that complement the perception-based findings.

Data Analysis

Prior to analysis, the collected data of the respondents were screened and coded for consistency and completeness. Descriptive statistics, including means, standard deviations, and percentages, were used to summarize perception variables and characteristics of respondents. Reliability analysis of the measurement constructs was measured by using Composite Reliability (CR) and Cronbach's alpha. Cronbach's alpha was used to assess the internal consistency of the questionnaire items, whereas Composite Reliability (CR) was calculated to evaluate construct measurement consistency and reliability. Construct-level mean scores were further calculated to evaluate residents' perceptions of satisfaction, motivation, and utilization patterns about the green spaces.

Results

Socio-demographic Characteristics of Respondents

A total of 110 respondents participated in the questionnaire survey.

Figure 4

Socio-Demographic Characteristics of Respondents

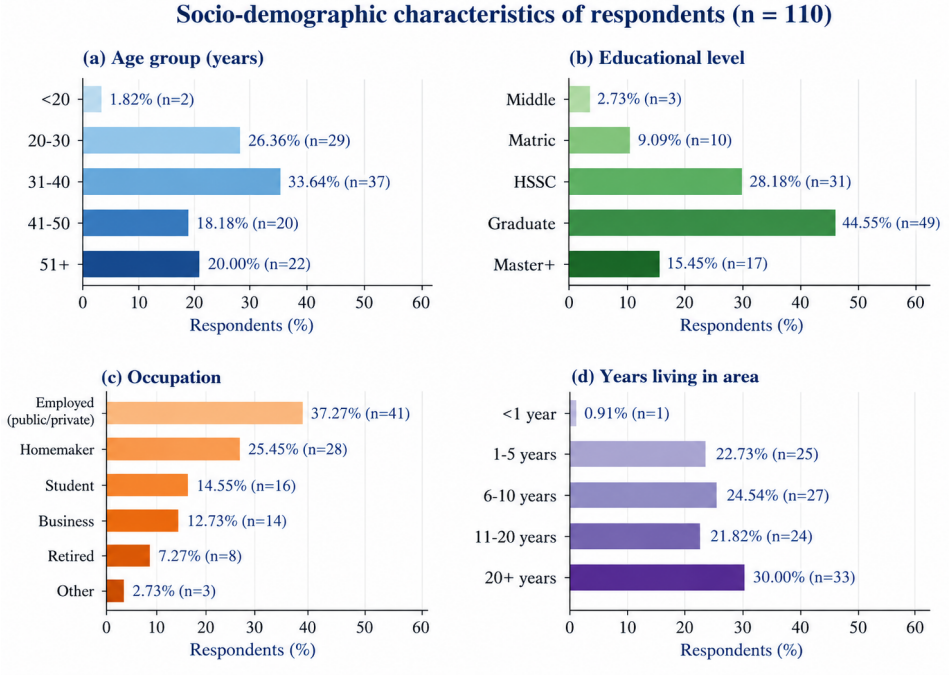


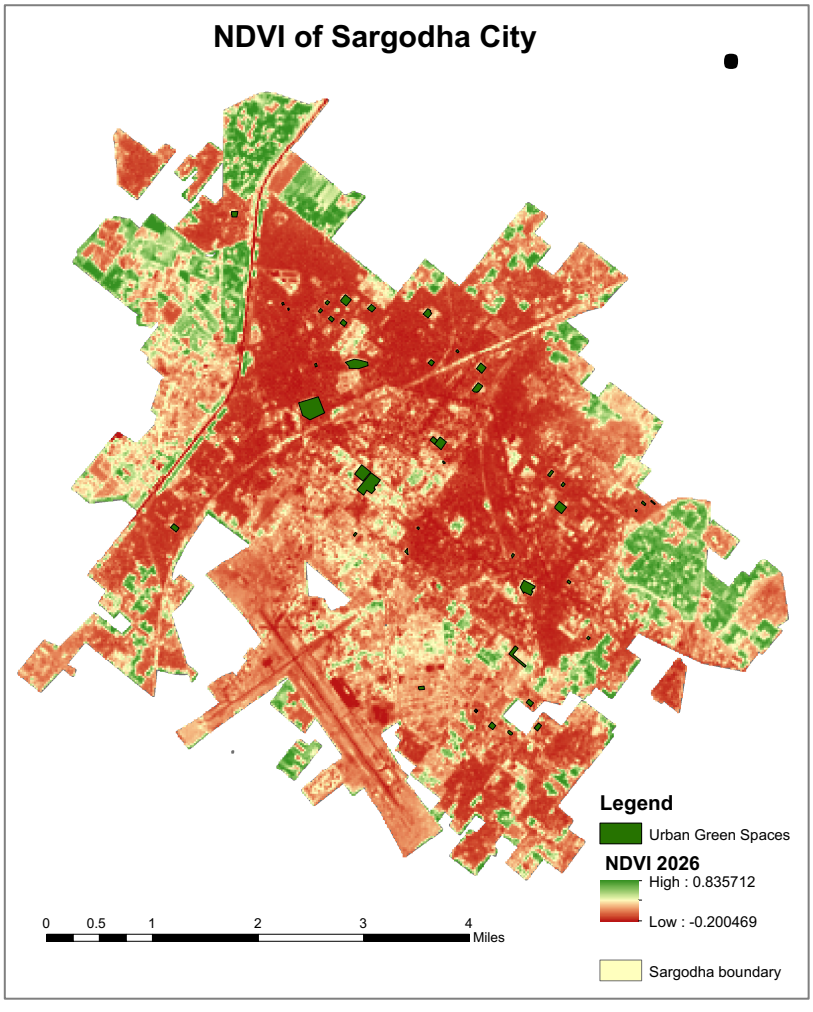
Figure 4 presents the diverse socio-demographic characteristics of the respondents, confirming a broad representation of residents in Sargodha City. The sample included participants from both genders and characterized diverse age groups, educational levels, occupations, and years of living in the area. In general, the profile shows a diversity of the sample appropriate for estimating residents' perceptions of urban green spaces.

Normalized Difference Vegetation Index (NDVI) of Sargodha City

The spatial distribution of the Normalized Difference Vegetation Index (NDVI) across Sargodha City is demonstrated in figure 5, depicting the current pattern of vegetation cover.

Figure 5

Normalized Difference Vegetation Index (NDVI) of Sargodha City (2026)



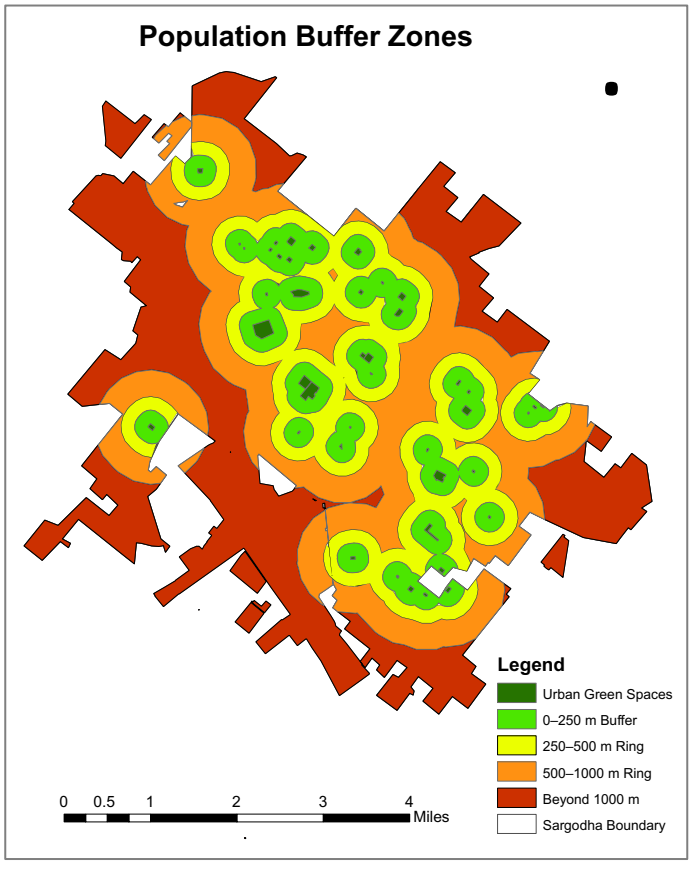
Higher values of NDVI are associated with dense vegetation regions and urban green spaces, while lower values of NDVI are mainly related to sparsely vegetated land, water bodies, and built-up areas. Spatial variation observed in this map shows that vegetation is not distributed properly across the area of the city. Dense green cover is inadequate in specific areas. The 2026 NDVI map also proves that most of the identified urban green spaces occur in areas of relatively high vegetation density, highlighting their role and reinforcing their ecological significance in the green infrastructure of the city. On the other hand, several urban neighborhoods show relatively low vegetation cover, signifying spatial disparities in the distribution of green spaces across the study area. Whereas the primary focus of this study is the perception of residents about urban green spaces, the NDVI analysis contributes a valuable environmental context for interpreting public perceptions of satisfaction, environmental quality, and accessibility.

Population Distribution Around Urban Green Spaces

To strengthen the perception-based findings, the spatial distribution of the population around urban green spaces was evaluated using the WorldPop dataset. Population estimates were calculated for four buffer zones (0–250 m, 250–500 m, 500–1000 m, and beyond 1000 m) surrounding urban green spaces (Browning & Lee, 2017).

Figure 6

Population Buffer Zones Around Urban Green Spaces



The estimated population residing within each buffer zone is presented in Table 2.

Table 1

Estimated Population within Urban Green Space Buffer Zones

Accessibility Zone	Estimated Population
0–250 m	179,673
250–500 m	237,298
500–1000 m	244,784
Beyond 1000 m	127,093

The analysis found that the largest estimated population almost 244,784 residents) resides within the 500–1000 m buffer zone, followed by 237,298 residents within the 250–500 m zone. Around 179,673 residents are located within 250 m of urban green spaces, accounting for the population with the highest proximity. Whereas 127,093 residents live beyond 1000 m from urban green spaces, representing relatively lower proximity. These findings indicate that although a significant proportion of the population of Sargodha City is located within the clear buffer zones, the

distribution of residents with respect to urban green spaces varies across the city. This spatial assessment strengthens the perception-based findings through empirical evidence of the population distribution around urban green spaces.

Perceptions of Environmental Quality of Urban Green Spaces

Residents' perceptions regarding urban green spaces were assessed using construct-level descriptive statistics. Table 2 presents the mean scores and standard deviations of the study constructs.

Table 2

Descriptive Statistics of Study Constructs

Rank	Construct	Mean	Std. Dev
1	EQ (Environmental Quality)	2.945	0.832
2	ATT (Attitude)	4.075	0.747
3	MOT (Motivation)	3.566	0.857
4	SAT (Satisfaction)	2.919	0.744
5	USG (Usage)	2.914	1.176

The findings indicate a moderate perception of the environmental quality of urban green spaces in Sargodha City. The Environmental Quality (EQ) construct recorded a mean score of 2.945 (SD = 0.832), signifying that respondents usually recognized the environmental importance of urban green spaces; however, issues concern regarding their management, quality, and condition of existing green spaces still exist. The rather low standard deviation reveals a moderate degree of agreement among respondents regarding environmental quality perceptions. Overall, the results suggest that improvements in the quality and management of urban green spaces may be required to enhance residents' experiences and perceptions.

Attitudes toward Urban Green Spaces

The Attitude construct demonstrated the highest mean score among all study constructs (M = 4.075, SD = 0.747), representing mostly positive attitudes toward urban green spaces among respondents. The finding specifies that residents hold very positive perceptions about urban green space and value various environmental, recreational, and social advantages associated with urban green spaces. The comparatively low standard deviation indicates strong consensus among survey respondents regarding the significance of urban green spaces. In general, a positive attitude toward urban green spaces is determined, and their contribution to the well-being of residents and role in urban livability are also recognized in the findings.

Motivation and Satisfaction

Construct-level descriptive statistics analyses were used to examine the motivation and satisfaction of survey respondents about the urban green spaces. In the analysis results, the motivation construct displayed a fairly high mean score (M = 3.566, SD = 0.857), suggesting that respondents tend to visit urban green spaces for various purposes such as social interaction, relaxation, and recreation. A quite lower mean value (M = 2.919, SD = 0.744) of satisfaction is recorded in contrast to motivation, suggesting a moderate satisfaction with the quality of existing urban green spaces, provided facilities, and necessary management. Although positive attitudes toward the urban green spaces and favorable motivation are suggested in the findings, actual satisfaction remains quite limited with the quality, facilities, and management regarding urban green spaces.

Utilization Patterns of Urban Green Spaces

A mean score of 2.914 (SD = 1.176) was observed for the utilization of Urban green spaces in the statistical analysis, indicating moderate usage levels among respondents. The relatively high standard deviation indicates a notable difference in experiences and utilization patterns between residents. The findings suggest moderate levels of urban green space utilization among respondents. The mean value lower than 3.0 indicates that urban green spaces are not widely utilized by all residents, possibly reflecting concerns about the limitations associated with individual preferences, facilities, quality, or accessibility.

Compared with all other constructs, the Usage construct showed the highest standard deviation, demonstrating a considerable variation in utilization patterns and experiences of respondents. Overall, the results suggest that there is still considerable potential to enhance the use of urban green spaces through management, improved planning, and development of attractive green infrastructure.

Reliability Analysis

The reliability of the measurement constructs was measured using Cronbach's alpha and Composite Reliability (CR). Table 3 presents the reliability statistics of the study constructs.

Table 3

Reliability Statistics of Study Constructs

Construct	Cronbach's Alpha	Composite Reliability
EQ	0.876	0.972
ATT	0.837	0.954
MOT	0.853	0.959
SAT	0.941	0.988
USG	0.914	0.977

The results suggest an acceptable and satisfactory reliability for all constructs, with Cronbach's alpha values ranging from 0.837 to 0.941 and Composite Reliability values ranging from 0.954 to 0.988. The obtained reliability values exceed the recommended threshold value of 0.7 (Sarstedt et al., 2021), confirming the consistency and adequacy of the measurement constructs applied in this study.

Among the constructs, Satisfaction (SAT) exhibited the maximum Cronbach's alpha value (0.941), representing excellent reliability, while Attitude (ATT) recorded the lowest value (0.837), which still continued to exceed the recommended threshold. Overall, the findings demonstrate that the measurement scales used in this study are suitable and reliable for the following analyses.

Discussion

Attitudes toward Urban Green Spaces

The findings showed highly positive attitudes toward urban green spaces among the respondents, with the Attitude construct exhibiting the highest mean score (M = 4.075). This suggests that the importance of urban green spaces is strongly recognized by residents and that they also appreciate their recreational, social, and environmental benefits. Corresponding findings have been stated in previous studies, which proved that urban residents usually perceive green spaces as crucial components of well-being and urban livability (Giannico et al., 2021; Hanif et al., 2024).

The positive attitudes observed in Sargodha may indicate the growing recognition of green infrastructure and the increasing public awareness about environmental issues in rapidly urbanizing cities.

Environmental Quality Perceptions

Although respondents expressed generally favorable attitudes, perceptions about the environmental quality of urban green spaces were relatively moderate (M = 2.945). This finding suggests that respondents may have concerns about the maintenance, management, cleanliness, and quality of existing green spaces. Comparable observations have been reported in Prior studies, which found that the condition and perceived quality of urban green spaces significantly influence the satisfaction levels and experiences of residents (Nasution & Zahrah, 2014; Biernacka & Kronenberg, 2018).

The comparatively moderate environmental quality perceptions noted in Sargodha may result from the increasing pressure on existing green infrastructure and rapid urban expansion. Unequal provision and Limited maintenance of quality green spaces may adversely affect the evaluations of residents about the urban environmental conditions.

Satisfaction and Motivation

The findings specify comparatively high levels of motivation to visit urban green spaces (M = 3.566), signifying that residents are mostly interested in utilizing these spaces for physical activities, recreation, social interaction, and relaxation. However, satisfaction levels continued to be comparatively lower (M = 2.919), indicating that existing urban green spaces may not adequately meet expectations of residents.

This inconsistency between satisfaction and motivation has also been recognized in previous studies, which stated that although urban residents acknowledge the importance of green spaces and are motivated to use them, inadequacies in safety, facilities, accessibility, and maintenance often restrict their satisfaction (Vujcic et al., 2019; Giannico et al., 2021).

Utilization Patterns of Urban Green Spaces

Utilization of urban green space also recorded a moderate level (M = 2.914). The findings indicate that even though residents use urban green spaces, utilization is still lower than expected, despite their high motivation and positive attitudes. Earlier studies have indicated that the attractiveness, accessibility, and management of urban green spaces have an important influence on shaping the perceptions of residents and utilization of these spaces (Biernacka & Kronenberg, 2018).

The relatively high variation in patterns of utilization among respondents further indicates that opportunities and experiences for using urban green spaces change across neighborhoods and residents.

Spatial Context of Urban Green Spaces

The spatial analyses contributed additional geographical and environmental context for interpreting perceptions of residents related to urban green spaces in Sargodha City. The 2026 NDVI (Normalized Difference Vegetation Index) map showed that vegetation is unevenly distributed across the city, with comparatively higher vegetation values located within identified urban green spaces and relatively lower vegetation values found in densely built-up areas.

The finding suggested that vegetated areas are dominantly served by urban green spaces across the city, and also play a role in preserving the quality of the urban environment. The findings from the population distribution analysis revealed that within accessible buffer zones neighboring the urban green spaces, a large proportion of residents of the city are located. Specifically, the highest population of 244,783.55 was found within the 500–1000-meter

accessibility buffer zone, thereafter 237,298.43 within the 250–500-meter buffer zone, and then 179,672.95 within the 0–250-meter buffer zone, whereas the relatively smaller population of 127,093.07 resided beyond the 1000-meter accessibility buffer zone. These findings indicated that a substantial share of residents had convenient walking access to neighboring urban green spaces, whereas a large number of respondents still reside beyond the 1000 m accessibility zone. The distribution of urban green spaces and the residential population both indicates the significance of spatial variation. In general, questionnaire-based findings are supported by both NDVI analysis and population distribution. Nearby residential areas and environmental conditions around the urban green spaces provided the objective insight of the study. At the same time, subjective experiences and evaluations about these spaces are demonstrated by the perception of residents. A comprehensive understanding of the current distribution of vegetation and population residing near the existing urban green spaces is provided by spatial analysis. An inclusive understanding regarding the urban green spaces in Sargodha city is attained by the integration of both objective and subjective approaches, to contribute to data-driven planning for sustainable urban growth.

Planning Implications

The findings foster the sustainable management of ecological infrastructure and Sustainable urban development in medium-sized cities such as Sargodha. While residents reflect a strong motivation and positive attitudes toward urban green spaces, moderate levels of satisfaction and utilization show deficiencies in the management and existing provision of green infrastructure. These findings recommend the need for improving the maintenance, attractiveness, and quality of urban green spaces and ensuring their equitable distribution across urban areas. Developing green infrastructure may not merely increase satisfaction and utilization of residents but may also contribute to public well-being, environmental sustainability, and overall urban livability.

The NDVI analysis shows that vegetation is unevenly distributed across Sargodha City. So, future urban planning should prioritize increasing vegetation cover in densely built-up neighborhoods where green infrastructure is relatively limited. Population distribution surrounding the existing urban green spaces suggests that future planning should focus on the spatial distribution of residents to make sure that newly developed green spaces efficiently serve growing residential areas and expand the overall availability of urban green infrastructure. Incorporating the perceptions of residents with spatial information offers an inclusive basis for evidence-based urban planning. This approach can support local authorities in identifying priority areas for green space expansion, conservation, and management alongside promoting sustainable and people-centered urban development.

Conclusion

This study examined perceptions and utilization of urban green spaces by residents in Sargodha City, Pakistan. The findings highlighted that residents reflect highly positive attitudes toward urban green spaces and are relatively motivated to utilize them for environmental, social, and recreational purposes. However, perceptions concerning satisfaction, actual utilization, and environmental quality remained relatively moderate, signifying that existing urban green spaces may fail to fully meet the expectations and needs of residents.

The findings imply that deficiencies related to the management, quality and maintenance of urban green spaces may limit experiences and utilization patterns of residents. Therefore, improving the management and provision of urban green infrastructure should be taken into consideration as a priority for local authorities and for urban planners.

This study contributes to a relatively limited empirical literature regarding public perceptions of urban green spaces in medium-sized Pakistani cities and emphasizes the importance of incorporating experiences of residents into

processes of urban planning. The findings may facilitate planners and policymakers in developing equitable, human-centered, and sustainable strategies about urban green infrastructure.

Limitations and Future Research

This study is constrained by certain limitations. First, the findings are derived from a cross-sectional survey conducted in a single city and may not comprehensively represent other urban contexts in Pakistan. Second, the study was based on a relatively small sample size (110 respondents), which may reduce the generalizability of the findings. Third, the NDVI and WorldPop datasets were used only to offer a supporting spatial and environmental context and should not be taken as direct measures of perception of resident or urban green space use. Future studies may incorporate higher-resolution spatial data and a larger sample size across multiple cities to provide a comprehensive understanding of perceptions and utilization of residents concerning the urban green spaces in Pakistan.

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