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ORIGINAL

Functional performance of green areas and public space architecture

Desempeño funcional de áreas verdes y arquitectura del espacio público

Yoel Alexander Quispe Saavedra[1], Percy Roman Larico Viamonte[1], Roy Saul Salas Ballejo[1], Jhandy Robert Avalos Condori[1], Alejandro Paucar Guzman[1], Louis Enrique Ali Quispe[1], David Hugo Bernedo-Moreira[1], Rafael Romero-Carazas[1]

[1]Facultad de Ingeniería y Arquitectura, Escuela Profesional de Arquitectura y Urbanismo, Universidad Peruana Unión. Perú.

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Corresponding Author: Yoel Alexander Quispe Saavedra

ABSTRACT

Well-designed and accessible green spaces offer residents places for recreation and relaxation, helping to reduce stress and encourage physical exercise. In this sense, the objective of this study was to determine the relationship between the functionality of green areas and urban design in the city of Juliaca. For this purpose, a quantitative, non-experimental and correlational approach was used. The sample consisted of 223 inhabitants and neighbors of the main parks and squares of the unit of analysis, to whom a questionnaire was administered, with a reliability index of 0,889. The results showed a coefficient Rho=0,670 and a p value of 0,000, indicating a moderately strong positive correlation. This suggests that as one variable increases, the other also tends to increase in an orderly fashion, although not necessarily at a constant or linear rate. It is concluded that a well-integrated architecture with the design of green areas not only improves the aesthetics and functionality of these spaces, but also contributes to the quality of life of its citizens.

Keywords: Functionality of Green Areas; Urban Design; Integrated Architecture; Quality of Life.

RESUMEN

Espacios verdes bien diseñados y accesibles ofrecen a los residentes lugares para el esparcimiento y la relajación, ayudando a reducir el estrés y fomentar el ejercicio físico. En ese sentido, el objetivo del presente estudio fue determinar la relación de la funcionalidad de las áreas verdes y el diseño urbano en la ciudad de Juliaca. Para ello se utilizó el enfoque cuantitativo, no experimental y correlacional. La muestra estuvo conformada por 223 habitantes y vecinos de los principales parques y plazas de la unidad de análisis, a quienes se les aplicó un cuestionario, cuyo índice de fiabilidad fue de 0,889. Los resultados mostraron un coeficiente Rho=0,670 y un p valor de 0,000 lo que indica una correlación positiva moderadamente fuerte. Esto sugiere que, a medida que una variable aumenta, la otra también tiende a aumentar en una forma ordenada, aunque no necesariamente a un ritmo constante o lineal. Se concluye que una arquitectura bien integrada con el diseño de las áreas verdes no solo mejora la estética y la funcionalidad de estos espacios, sino que también contribuye a la calidad de vida de sus ciudadanos.

Palabras clave: Funcionalidad de Áreas Verdes; Diseño Urbano; Arquitectura Integrada; Calidad de Vida.

INTRODUCTION

Functional urban green areas provide a wide range of ecosystem services, such as improved air quality, rainwater management, and support for biodiversity. These services are essential for mitigating the effects

of climate change and improving the well-being of inhabitants.[1] Likewise, the design of urban green spaces, to be considered functional, must fulfill multiple functions and provide benefits, such as places for recreation and leisure, and also act as ecological corridors that facilitate the connection between urban and peri-urban habitats, promoting biodiversity conservation.[2]

In this context, in Asia, Liu et al.[3] concluded on the relationship between the functionality of green areas and urban design, emphasizing the need to enhance the functionality of the green regions through the use of native plants in the design of urban green areas to improve the composition of plant communities in urban environments and increase biodiversity and ecosystem stability. In addition, it beautifies urban gardens and strengthens the resilience of urban ecosystems in the face of adversity. This approach not only contributes to environmental sustainability but also promotes more balanced and aesthetically harmonious urban development.

Lafrenz[4] concluded that there is a positive relationship between the functionality of green areas and urban design, emphasizing that biodiversity in urban green spaces can significantly improve environmental quality and provide psychological benefits to residents. He et al.[5] pointed out a relationship between the functionality of green areas and urban design, emphasizing that citizen participation in public green spaces, such as parks and squares, promotes social cohesion and community interaction. This type of design is crucial in densely populated urban areas to strengthen social ties and improve overall urban quality of life. They also emphasize that proximity to nature enhances the health of many people, especially in urban areas.

In Europe, Evans et al.[6] concluded that the functionality of green areas in cities should be promoted through urban design in parking lots as spaces of opportunity. This innovation leads to an increase in the implementation of green roofs and living walls, as well as other systems that facilitate the prosperity of nature in environments that would typically be adverse. Many of these systems are incorporated into office complexes, universities, and various “clean” urban buildings.

Similarly, Guo et al.[7] concluded on the importance of urban trees, which play a vital role in promoting environmental sustainability, improving air quality by absorbing pollutants and releasing oxygen, mitigating stormwater runoff by intercepting rain, and contributing to carbon sequestration. Recommending that government agencies and decision-makers identify areas with low coverage and focus their efforts on implementing strategies to improve the functionality of the green regions, conserve natural resources, and promote overall ecological balance through specialized architectural design, since access to green areas and trees in urban environments is associated with reduced stress, better mental health, and increased physical activity, it is crucial to plan and make informed decisions about urban design and infrastructure development, considering the potential impacts on existing green cover. They point out that by integrating the dataset into urban design and planning, policymakers can ensure the preservation of existing green areas, strategically plan the planting of green spaces, and create sustainable and livable urban environments, offering natural solutions for climate change adaptation, including temperature regulation, stormwater management, and carbon sequestration. Schindler et al.[8] conclude in a critical assessment of how urban green areas (UGAs) are measured and provide information about urban design. Traditionally, the availability of these areas is calculated per capita, but this method does not accurately reflect how people use them. A study conducted in three European cities investigated the distances people travel to reach these areas and found that these distances are greater than those envisaged by policy targets, suggesting that current policies may be inadequate.

In North America, Rigolon et al.[9] report that architectural design has relegated the functionality of green spaces in cities, with the result that parks, trees, and other vegetated areas are distributed unevenly; The most disadvantaged sectors are those that are home to low-income people and communities of color, who have significantly limited access to these natural resources. For their part, Falfán et al.[10] highlight the importance of urban green areas in North America, mentioning that they play a fundamental role in improving water quality and providing ecosystem services that benefit society. These green areas, such as floating treatment wetlands, can have a significant impact on water cleaning and filtration, as well as on improving water quality in urban environments. In the same context, Paudel et al.[11] mention that studies conducted in North America highlight the ecosystem services provided by urban green spaces, including environmental, ecological, and social benefits. It is noted that the management of intensively maintained urban lawns is a dominant feature of urban green spaces globally, underscoring the importance of understanding the exchanges and synergies in the sustainable management of these spaces in the region.

In Central America, Romero et al.[12] concluded that, from a functionality perspective, green space accounts for around 40,28 % of the territory, of which only 8,95 % is dedicated to conservation, protected areas, and recreational spaces. They recommend promoting greater emphasis on the functionalities of green areas through design that incorporates sustainable urban characteristics. Consequently, Castillo-Cabrera et al.[13] highlight the importance of urban green areas as fundamental elements for urban sustainability and the quality of life of their inhabitants. They emphasize that these areas not only contribute to the well-being of the population but also play a crucial role in sustainable urban planning by promoting biodiversity, facilitating interaction between humans and nature, and serving as meeting and communication spaces in the city. Similarly, Piaggio[14] highlights

that urban green areas in Central America play a fundamental role by providing benefits such as recreational spaces, water regulation, air purification, and aesthetic aspects. These areas not only offer recreational opportunities but also contribute to improving the quality of life of the population and the environmental sustainability of cities in the region.

In South America, Souza et al.[15] concluded that urban green spaces play a functional role in urban design, as they encourage human interaction with nature and offer multiple benefits to both society and the local environment. They recorded an index of 0,54 m^2 per inhabitant, which falls short of the minimum of 5 % established by local legislation. Van der Hoff et al.[16] concluded that the functionality of green areas is related to sustainable urban design. However, there are still research gaps, and much work is needed to advance this science for policies in South America. The knowledge produced by research approaches other than valuation studies, particularly descriptive studies, is much more abundant, at least in South America. This attests to the difficulties involved in (monetary) valuation.

Cutipa et al.[17] concluded that there is a positive relationship between the functionality of green spaces. They planned architectural design, demonstrating that it improves landscape quality, increases biodiversity, and enhances the well-being of inhabitants, contributing to maintaining a balance between green spaces, equity, and citizen participation in cities. However, public intervention policies need to be developed to establish a solid theoretical basis for achieving the objective of promoting the functionality of urban green areas.

Krugger et al.[18] concluded that there is a significant relationship between the distribution of public spaces and the functionality of green areas, highlighting their importance for learning to live together and promoting recreational activities. They suggest that the municipality should allocate a budget to create more functional green spaces through specific strategies inherent to municipal governments.

In the same context, the World Health Organization (WHO) establishes that each inhabitant should have 13m2 of green and recreational space. In this context, the city of Juliaca has a population density of 371 000 inhabitants, which implies a need for 482 hectares of green and recreational areas. However, only 64,01 hectares are available. In addition, rapid and poorly planned urban growth has generated a series of urban problems that affect the quality of life of its inhabitants. About the present study, the expansion of the urban area has led to a reduction in functional green areas, which could hurt social well-being, highlighting the need to effectively integrate green areas into planned urban design and promote sustainable development. The situation is aggravated by the fact that many of the existing green spaces are poorly distributed, inaccessible to a large part of the population, or in suboptimal condition, which limits their ability to provide environmental, social, and economic benefits. In addition, the lack of urban design that considers the harmonious integration of nature into the urban fabric has led to additional problems such as heat islands, air pollution, and a decline in the aesthetic and functional quality of urban spaces.

For these reasons, the main objective of this study was to determine the relationship between the functionality of green areas and urban design in the city of Juliaca in 2024. This research is also justified on a social level, as the town of Juliaca faces significant challenges arising from rapid urban growth that has limited the development and maintenance of functional green areas for recreation, physical activity, and social gatherings. Urban green areas play a vital role in mitigating public health problems associated with urbanization, such as stress and respiratory diseases. This study aims to determine the relationship between these variables to promote social inclusion and propose ecological and recreational benefits for the entire community of Juliaca.

Theoretically, this study will contribute to the existing academic body on sustainable urban planning and green space design, providing empirical evidence on the relationship between the functionality of green areas and ecological, administrative, recreational, and urban indicators, and their relationship with urban design.

From a practical standpoint, the results of this research will provide guidelines that architects and urban planners can use, or those responsible for policy-making and local communities, to make informed decisions that improve green infrastructure and, ultimately, the quality of life in Juliaca.

METHOD

The research was basic, quantitative, non-experimental, and correlational. In this regard, Sotomayor et al.[19] state that basic or pure studies aim to generate and increase knowledge. For their part, Cortez et al.[20] refer to the quantitative approach as being based on observations and measurements to collect information through surveys, which allows the problem to be identified and analyzed. Similarly, Choque et al.[21] state that non-experimental research cannot control variables. For Alatrista et al.[22], the correlational level focuses on establishing relationships or associations between variables, without delving into the causality of these events.

The population consisted of residents of the main parks and squares in the city of Juliaca: Plaza de Armas, Plaza Bolognesi, Parque Grau, Plaza Zarumilla, Plaza Las Carmelitas, Parque Cholo, and Parque del Músico, numbering 530 families. The sample consisted of 223 residents. According to Moroń et al.[23], in the context of scientific research, the term population refers to the complete set of individuals, cases, or elements that have

a common characteristic and are the subject of study. Gong et al.[24] point out that a sample refers to a subset of the population that is selected for study. This subset is composed of individuals, cases, or elements that represent the characteristics of the broader population from which they are drawn. The sample is crucial for obtaining data that can be analyzed and generalized to the total population, especially when it is not practical or possible to study all members of that population.[25]

As an inclusion criterion, it was established that the instrument would be applied to residents of the aforementioned parks and squares who were present in their homes at the time the information was collected.[26]

Minors and those who were visitors or passers-by at the time of application were excluded.

RESULTS

Descriptive results

Table 1. Descriptive results for green area functionality

	Freq.	%	% Val.	% Accum.
Low	116	52	52	52
Average	89	40	40	92
High	18	8	8	100
Total	223	100	100	

Table 1 presents the descriptive results of this study, revealing a predominance of low functionality (52 %). This indicates that most green areas in Juliaca are classified as having low functionality, suggesting that these spaces may be underutilized or poorly designed to meet resident needs. This may reflect several factors, such as inadequate maintenance, lack of facilities (such as benches, lighting, and paths), and unequal distribution that does not reach the entire population equitably.

Forty percent of green areas have medium functionality, suggesting that while these spaces offer some benefits, there are still significant opportunities for improvement. Medium functionality may indicate that the areas are reasonably well maintained but lack sufficient features or services to encourage greater use and appreciation by the community.

Only a small percentage (8 %) of green areas are considered highly functional, which may indicate that these few places are well designed, well maintained, and well integrated with the needs and activities of the local community.

These results are a call to action for urban planners, local authorities, and the community of Juliaca, focusing on the need to improve the functionality of green areas to achieve a more sustainable and socially inclusive urban design.

Table 2. Descriptive results for urban design

	Urban aspect	Architectural aspect	Public space
Poor	33	59	57
Moderate	61	39	39
Optimal	6	1	4
Total	100	100	100

Table 2 shows the descriptive results of the urban design variable in its three dimensions: urban appearance, architectural appearance, and public space.

About urban appearance, it is deficient (33 %), meaning that one-third of the city shows poor urban design, indicating problems in urban planning and development that may include a lack of adequate infrastructure, poor connectivity and accessibility, and possible disorganization in the distribution of urban spaces. It is moderate (61 %), meaning that most areas have a moderate level of urban design, suggesting that, although functional to a certain extent, these spaces do not achieve a level of excellence or are not fully adapted to the needs of the inhabitants. There may be compromises in the quality and sustainability of urban development. It is optimal (6 %), meaning that only a small percentage of the city reflects optimal urban design, indicative of well-planned and developed areas with a comprehensive vision that incorporates accessibility, aesthetics, and functionality.

In terms of architecture, it is deficient (59 %), meaning that more than half of the architecture in Juliaca is classified as deficient, reflecting a significant problem in terms of construction quality, architectural design, and possibly the conservation of built heritage. This can result in spaces that do not inspire or function adequately

for their users. It is moderate (39 %), meaning that a considerable percentage of the architecture is functional but unremarkable, indicating that, although the buildings serve their basic purposes, there is a lack of design vision that better integrates aesthetics, innovation, or energy efficiency. It is optimal (1 %), indicating that the city has virtually no examples of architectural excellence, which presents an excellent opportunity for improvement in the design and construction of new developments and the renovation of existing structures to raise standards.

In terms of public space, it is deficient (57 %), meaning that more than half of public spaces are deficient, which could imply problems with their accessibility, safety, equipment, and maintenance. These problems reduce the quality and enjoyment of shared spaces, which are essential for social and community well-being. Moderate (39 %) means that public spaces in this category may offer basic functionality but lack elements that encourage more intensive and satisfying use by the community. It is optimal (4 %), with only a small percentage of public spaces classified as optimal, suggesting that there are isolated examples of successful design that could serve as models for future interventions in other sectors of the city.

These data suggest that Juliaca faces significant challenges in terms of urban design, architecture, and the configuration of public spaces. The predominance of moderate and poor ratings indicates the need for a renewed and more ambitious approach to urban planning and design.

Inferential results

Table 3. Contingency table for general hypothesis

			Urban design
Spearman's rho	Functionality of green areas	Correlation coefficient	0,670**
		Sig. (bilateral)	0

**. The correlation is significant at the 0,01 level (bilateral).

Table 3 shows a Spearman's Rho coefficient of 0,670, which indicates a moderately strong positive correlation. This suggests that as one variable increases, the other also tends to increase in an orderly fashion, although not necessarily at a constant or linear rate. Meanwhile, the p-value of 0,000 infers that as urban design improves in terms of accessibility, integration, and quality of public spaces, the functionality of green areas also improves. This may imply that interventions aimed at improving urban design are likely to have a direct positive impact on how green areas can be used and valued by citizens.

Table 4. Contingency table for specific hypotheses

		Functionality of green areas	Urban appearance	Architectural appearance	Public space
Functionality of green areas	CC	1,000			
	Sig. (b)				
	N	223			
Urban appearance	CC	0,557**	1,000		
	Sig. (b)	0,000			
	N	223	223		
Architectural appearance	CC	0,555**	0,409**	1,000	
	Sig. (b)	0	0		
	N	223	223	223	
Public space	CC	0,432**	0,542**	0,471**	1,000
	Cont. (b)	0	0	0	
	N	223	223	223	223

The results reported in table 4 reveal statistically significant relationships between the functionality of green areas and various aspects of the city's urban and architectural design. These results are based on Spearman's correlation coefficient (Rho) values and the corresponding very low p-values (0,000), indicating strong statistical significance.

Regarding the functionality of green areas and urban appearance, the Rho coefficient of 0,557 suggests a

moderate positive correlation between the functionality of green areas and the quality of urban appearance. This implies that improvements in urban planning and the integration of well-designed public spaces are associated with greater functionality of green areas. This correlation may reflect how effective urban design contributes to making green areas more accessible, safe, and attractive to citizens.

About the functionality of green areas and architectural appearance, the coefficient of 0,555 indicates a moderate positive correlation between the functionality of green areas and the architectural appearance of the city. This result suggests that architectural quality, including the design and maintenance of nearby buildings and structures, influences how green areas are perceived and used. Harmony between architecture and green areas can improve the overall aesthetics and usefulness of these spaces.

Regarding the functionality of green areas and public space, the Rho coefficient of 0,432 shows a positive correlation, although lower than the previous ones, between the functionality of green areas and the quality of public space. This suggests that, despite a positive association, other factors also influence the contribution of public spaces to the functionality of green areas.

DISCUSSION

The findings of this study underscore the importance of considering green areas as an integral component of urban planning and design. They are consistent with Liu et al.[3], who suggest that well-targeted interventions in urban design not only enrich the urban landscape but also optimize the utility, enjoyment, and ecological value of green areas, thereby benefiting the community at large.[27,28]

Given the positive and direct impact of urban design on the functionality of green areas, future policies and projects in Juliaca need to incorporate strategic considerations for the development and improvement of these areas. This is in line with the position of Lafrenz[4], who suggests the implementation of specific measures to improve accessibility, safety, and connectivity between green areas and other urban spaces, ensuring that these places not only exist but are effectively accessible and enjoyable for all citizens.[29]

The correlation found implies that well-integrated and accessible green areas within a coherent and well-thought-out urban design not only improve the aesthetic quality of the city but also offer tangible benefits to its citizens. In line with He et al.[5], these benefits include, but are not limited to, improved mental and physical health, the creation of spaces for socialization and recreation, and the promotion of a more sustainable and resilient urban environment. In agreement with Guo et al.[7], the improved functionality of green areas, as a result of effective urban planning and design, can contribute significantly to the environmental sustainability of the city, helping to mitigate the effects of climate change by providing areas for carbon capture and reducing the urban heat island effect.[30]

To this end, architects, as urban planners, should design with a holistic vision that considers both built space and green spaces. This includes selecting materials, colors, and shapes that complement the natural landscape, as well as planning views and direct access to green areas from surrounding buildings. Similar to Rigolon et al.[9], designers should consider how architectural features can serve to attract more people to green areas, for example, by creating shaded areas, well-placed benches, and attractive paths that invite exploration and enjoyment.[31]

The study demonstrates that architecture that is well integrated with the design of green areas not only improves the aesthetics and functionality of these spaces but also contributes to the quality of life in the city of Juliaca. In agreement with Souza et al.[15], who state that conscious and coordinated planning and design can transform these spaces into valuable assets for the city, fostering a healthier, more sustainable, and aesthetically pleasing urban environment, the development and promotion of programs and activities that encourage the active use of green spaces can increase their functionality. This can include sporting events, farmers' markets, educational activities about nature, and community festivals.

The present study is consistent with Cutipa et al.[17], who highlight the importance of a symbiotic relationship between the quality of public space and the functionality of green areas in Juliaca. While the correlation is positive, the full impact of green areas on urban quality of life also depends on a broader range of factors, underscoring the need for a holistic approach to urban planning and public space design.

CONCLUSIONS

Based on the overall objective of the study, which sought to determine the relationship between the functionality of green areas and urban design in the city of Juliaca, this study has shown that there is a moderately strong positive correlation between the functionality of green areas and urban design in the city of Juliaca. This correlation is indicative of a proportional and direct relationship between these two variables. In practical terms, this means that improvements in urban design, specifically in areas such as accessibility, integration, and the quality of public spaces, tend to be associated with an improvement in the functionality of green areas.

About the first specific objective, the study conducted to determine the relationship between the

functionality of green areas and the urban appearance in the city of Juliaca has revealed significant results that underscore the interdependence between these two components of urban design. The data indicate a moderate positive correlation between the functionality of green areas and the urban appearance. This suggests that improvements in urban design and planning are closely linked to greater functionality of green areas, manifested in easier access, greater safety, and more attractive aesthetics in these essential spaces.

About the second specific objective, a moderate positive correlation was found between the functionality of green areas and the architectural appearance of the city. This result confirms that the architectural quality of buildings and structures near green areas has a notable impact on how these spaces are perceived and used by citizens. This moderate correlation suggests that well-designed and well-maintained architecture can significantly improve the usefulness and perception of green areas. The aesthetic and functional integration of architectural structures with green spaces not only enhances the beauty of the urban environment but also encourages more active and satisfying use of these areas. Architectural design, therefore, should not only consider the internal functionality and aesthetics of individual buildings, but also how these buildings interact with and complement the surrounding green spaces.

About the third specific objective, a positive correlation is found, although it is lower compared to other aspects of urban design examined. This suggests that, while there is a beneficial relationship between the quality of public space and the functionality of green areas, other factors also play an important role in how these green spaces function and are perceived by the community. The moderate correlation indicates that improvements in the quality of public space, such as improved design, accessibility, and maintenance, can have a favorable impact on how green areas are used and valued. However, the presence of other influential factors suggests that the design and management of public spaces should consider additional aspects such as safety, available services, and scheduled activities that may affect the user experience and perceived usefulness of green areas.

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CONFLICT OF INTEREST

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AUTHORSHIP CONTRIBUTION

Conceptualization: Quispe Saavedra Yoel Alexander, Larico Viamonte Percy Roman, Salas Ballejo Roy Saul, Avalos Condori Jhandy Robert, Paucar Guzman Alejandro, Ali Quispe, Louis Enrique, David Hugo Bernedo-Moreira, Rafael Romero-Carazas.

Data curation: Quispe Saavedra Yoel Alexander, Larico Viamonte Percy Roman, Salas Ballejo Roy Saul, Avalos Condori Jhandy Robert, Paucar Guzman Alejandro, Ali Quispe, Louis Enrique, David Hugo Bernedo-Moreira, Rafael Romero-Carazas.

Formal analysis: Quispe Saavedra Yoel Alexander, Larico Viamonte Percy Roman, Salas Ballejo Roy Saul, Avalos Condori Jhandy Robert, Paucar Guzman Alejandro, Ali Quispe, Louis Enrique, David Hugo Bernedo-Moreira, Rafael Romero-Carazas.

Drafting - original draft: Quispe Saavedra Yoel Alexander, Larico Viamonte Percy Roman, Salas Ballejo Roy Saul, Avalos Condori Jhandy Robert, Paucar Guzman Alejandro, Ali Quispe, Louis Enrique, David Hugo Bernedo-Moreira, Rafael Romero-Carazas.

Writing - proofreading and editing: Quispe Saavedra Yoel Alexander, Larico Viamonte Percy Roman, Salas Ballejo Roy Saul, Avalos Condori Jhandy Robert, Paucar Guzman Alejandro, Ali Quispe, Louis Enrique, David Hugo Bernedo-Moreira, Rafael Romero-Carazas.