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ECOLOGICAL IMPORTANCE OF URBAN GREEN SPACES (TASHKENT CASE STUDY)

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Abstract: This scientific article systematically analyzes the ecological, functional, and microclimatic importance of green areas in the context of modern urbanization, using the city of Tashkent as a case study. The relevance of the research is determined by the need to mitigate the “urban heat island” effect caused by global climate change and the rapid growth of the metropolis. The article examines landscape-architectural principles of planning urban green infrastructure, the compositional and ergonomic characteristics of open spaces, and their impact on public health.

During the study, vegetation cover in Tashkent was monitored using Sentinel-2 satellite data and GIS technologies, and the effectiveness of green areas in reducing surface temperature was substantiated through quantitative indicators. The results include practical recommendations for expanding green zones and modernizing irrigation systems within the framework of Tashkent’s Master Plan up to 2045. The study contributes to enriching the scientific basis for applying architecture-landscape solutions harmonized with nature in the process of urban redevelopment.

Keywords: Urban landscape architecture, green infrastructure, urban heat island effect, Tashkent 2045 Master Plan, sustainable urban planning, microclimate, ecological sustainability.

INTRODUCTION:

One of the most pressing issues of modern urban planning is the disruption of urban ecosystems caused by increasing anthropogenic pressure and the replacement of natural environments with artificial surfaces. The capital of Uzbekistan, Tashkent, as one of the largest metropolises in Central Asia, is currently experiencing a phase of rapid urbanization and economic development. However, this process, along with the expansion of urban areas, the growth of traffic flows, and the increase in construction density, is giving rise to several environmental problems such as excessive overheating of the urban environment, air pollution, and the functional decline of green spaces.

The climate of Tashkent is sharply continental, and high temperatures combined with low humidity during the summer season create uncomfortable living conditions for residents. It should be emphasized that hard and impermeable surfaces in the city (asphalt, concrete) absorb solar energy and re-emit it at night, resulting in the formation of the Urban Heat Island (UHI) effect. This leads to temperatures in central districts being up to 1.5–1.6°C higher than in peripheral areas.

The relevance of the research lies in the fact that, within the framework of the newly approved Master Plan of Tashkent up to 2045, the city’s population is expected to



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reach 7.4 million people, which makes the preservation of green areas and their strategic planning a vital necessity. The article aims to analyze the ecological efficiency of green spaces in Tashkent and develop architectural and landscape recommendations to optimize them within the urban planning framework.

To achieve this aim, the following tasks were defined: to monitor the current state of urban greening in Tashkent, to quantitatively analyze the impact of green zones on the microclimate, and to propose sustainable landscape design approaches based on

Shoniring the logical model of the research



Figure 1. Logical model for forming the city's green framework

international experience. The object of the research is the public green spaces and parks of Tashkent, while the subject of the research is the functional and compositional characteristics of these areas in ensuring microclimatic stability.

The scientific novelty of the work lies in the fact that, for the first time under the conditions of Tashkent, the correlation between the amount of green space and surface temperature is analyzed using modern remote sensing data, and a new model for urban planning renovation is proposed. The practical significance is that the developed recommendations can be applied in the implementation of the Master Plan and in the design of the urban landscape.

METHODS

In this study, a set of several interrelated methods was employed to investigate the complex ecological and spatial structure of the urban environment. First, through the comparative analysis method, areas of Tashkent with different levels of greening were compared from a microclimatic perspective, particularly low-rise, densely built (mahalla) zones and districts characterized by multi-storey buildings with extensive green spaces. The data were processed from thermal maps obtained using the Sentinel-2 and Landsat 8 thermal sensors.

Secondly, using the graph-analytical method, the land resources of Tashkent were analyzed, revealing that impermeable artificial surfaces (asphalt, concrete) occupy 78% of the urban area. This method also made it possible to visualize the uneven distribution of green zones throughout the city.



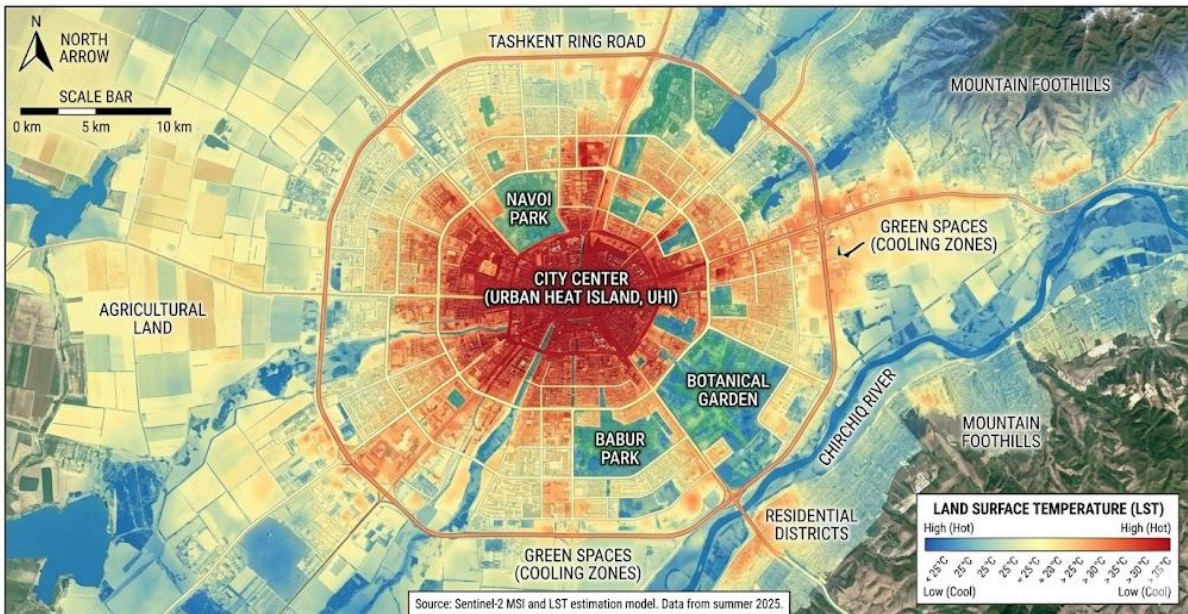


Figure 2. Thermal monitoring map of Tashkent (based on Sentinel-2 data)

In the study, the case-study method was applied to examine advanced practices in landscape architecture from major cities such as New York, Singapore, and Paris. Their aspects suitable for Tashkent’s continental climate, such as the “Garden City” concept and vertical greening techniques, were analyzed.

Finally, based on the project modeling method, new landscape-architectural models were developed to enhance the efficiency of green areas. In this process, the traditional “Method of Landscape Analysis” (MLA) and the modern “Method of Image-Based Landscape Design” (MOLD) approaches were integrated. During the modeling process, the key principles included the formation of an urban green framework, the creation of shaded alleys connected to the irrigation system, and the development of a “green belt.”

RESULTS

Research findings indicate that the ecological condition of Tashkent is directly linked to the quantity and quality of its green spaces. Currently, the city's total green area, including restricted and specialized zones, amounts to 7,120.9 hectares. However, the public green space per capita is only 3 square meters, which is significantly below urban planning standards. Analyses based on remote sensing data have quantitatively confirmed the cooling effect of green areas. Specifically, it was found that while the surface temperature in areas with multi-story residential buildings and extensive green zones (taking the Chilonzor district as an example) was 30°C, temperatures reached up to 35°C in dense, low-rise neighborhoods with limited greenery. This 5°C temperature difference demonstrates the strategic role of green infrastructure in microclimate management.

The research also identified patterns in the distribution of green zones throughout the city. More than 90% of the 20 largest existing parks are concentrated in areas near the city center, while a shortage of green spaces is observed in the peripheral north-western and south-eastern districts.

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Within the framework of the Tashkent City Master Plan until 2045, it is planned to create an additional 10,000 hectares of green zones and a 15,000-hectare 'green belt' around the city. This initiative will allow the per capita green space indicator to increase to 8 square meters.

Years	Total Green Area (ha)	Green Area per Capita (sq.m)	Urban Heat Island Intensity (°C)
2019	5000	19.6	4.5
2020	5050	19.4	4.4
2021	5120	19.3	4.3
2022	5200	19.3	4.2
2023	5350	19.5	4.0
2024 (projected)	5600	20.0	3.7
2025 (projected)	6000	21.1	3.3

Table 1. Tashkent city greening indicators (comparison 2019-2025)

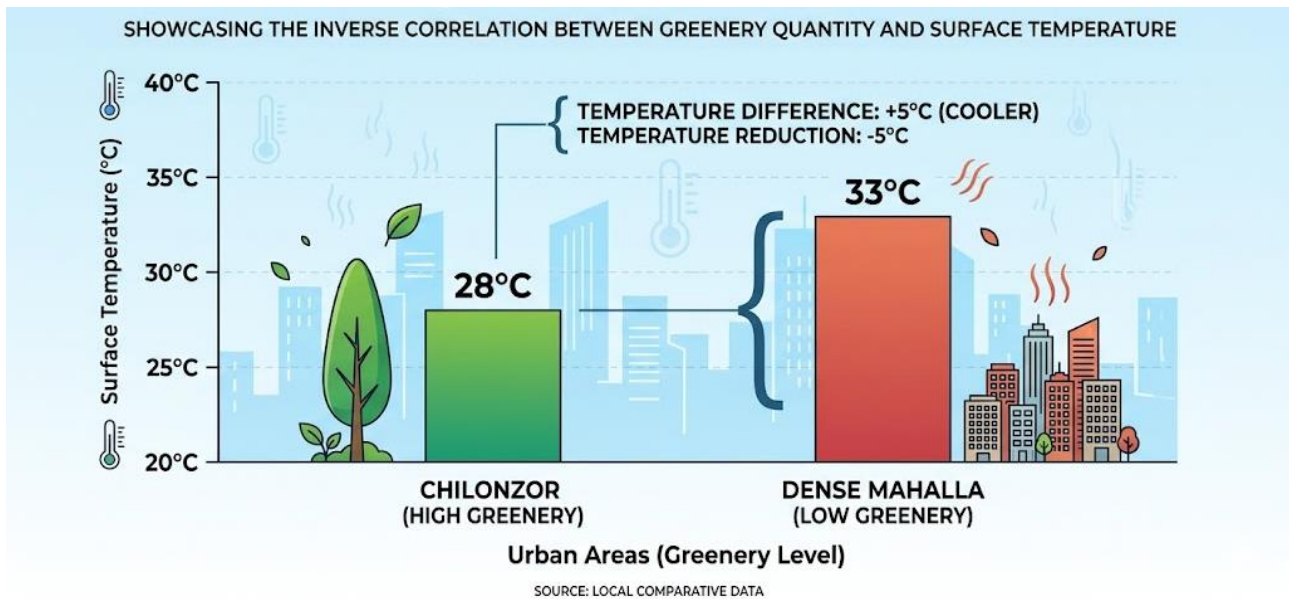


Figure 3. Effect of green areas on surface temperature (comparative analysis)

From an architectural-landscape perspective, it has been stipulated that construction projects in new renovation zones (totaling 300 plots) must be executed on the condition of preserving existing trees and the mandatory creation of new green spaces. Furthermore, the restoration of Tashkent’s historical irrigation system -canals and ditches (covering 100 km) - and the establishment of walking zones along their banks have been identified as key factors for revitalizing the city’s 'circulatory system'.

DISCUSSION



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The findings indicate that in the development of green spaces in Tashkent, focus should be placed not only on quantitative metrics but also on their functional and compositional quality. Currently, the replacement of many deciduous trees with coniferous (evergreen) species in Tashkent is diminishing one of the primary functions of landscape architecture: the capacity for cooling through shade and evapotranspiration. While coniferous trees are aesthetically pleasing, they cannot serve as effective 'urban lungs' compared to deciduous trees in a hot continental climate.

International experience, particularly Singapore's 'Garden City' concept, demonstrates that integrating green infrastructure with transport networks and buildings can reduce the urban heat island effect by 2–4°C. In the context of Tashkent, applying this approach through the 'Green Belt' project is of significant importance for protecting the city from dust storms and improving air circulation. At the same time, implementing the MOLD method in landscape design-creating a unique metaphorical image for each public space (for example, using the theme of water and traditional 'aryks' for promenades along the Anhor canal)-enhances the aesthetic appeal and national identity of the urban environment.

A primary limitation of this study is the absence of a comprehensive dendrological cadastre covering all districts of Tashkent, which complicates the aggregation of precise statistical data for certain areas. In the future, it is essential to develop an automated database utilizing GIS (Geographic Information System) technologies to monitor the individual status and health of each tree.

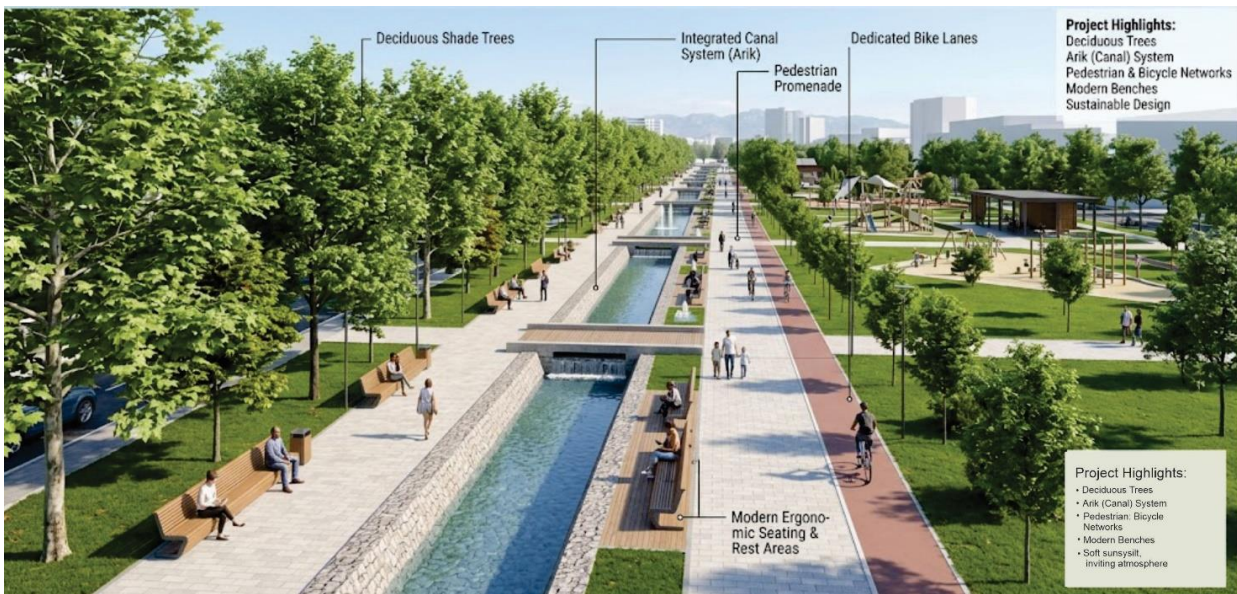


Figure 4. Visualization of a recommended landscape-architecture solution for a new green park and boulevard in Tashkent city

CONCLUSION

The study conducted, using Tashkent as a case study, confirmed that green spaces fulfill not only aesthetic roles but also vital ecological and microclimatic functions. The expansion of green areas and their proper integration into the urban planning structure serve as a primary means of significantly mitigating the 'urban heat island' effect and creating a comfortable, ergonomic environment for the population.



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Based on the research results, the following practical recommendations are proposed:

Firstly, in urban renovation and new construction projects, the share of deciduous trees



Figure 5. Model of sustainable landscape design principles in urban planning

should be mandated at a minimum of 70%, with compositional designs developed specifically to maximize their shading radius.

Secondly, restoring Tashkent's traditional irrigation system (aryks) by integrating it with modern drip irrigation technologies will ensure both the humidification and cooling of the city's microclimate.

Thirdly, establishing a seamless connection between the 15,000-hectare "green belt" on the city's periphery and the internal framework of parks and alleys will facilitate the creation of a unified ecological network.

Future research should focus on a deeper analysis of the economic efficiency of urban green spaces and their direct impact on real estate values.

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