



Green spaces in Uzbekistan: Historical heritage and challenges for urban environment

Young-Jin Ahn, Zuhridin Juraev^{*}

Department of Geography, Chonnam National University, Yongbong-Ro 77, Buk-Gu, Gwangju 500-757, Korea

ARTICLE INFO

Keywords:

Green space
Sustainable development
Historical gardens
Urban studies
Geographical research

ABSTRACT

Green spaces have gained increasing urgency due to the global and local challenges resulting from rapid urbanization and environmental issues. This study specifically focuses on the design, management, and crucial significance of urban green spaces in Uzbekistan within the framework of sustainable development. Through the integration of diverse theoretical perspectives and interdisciplinary approaches, the study seeks to enhance biodiversity, facilitate wildlife movement, and promote environmental sustainability within urban green spaces. The research methodology employed in this study is robust, encompassing comprehensive data analysis, which provides compelling evidence of the positive impacts of green spaces on both physical and mental well-being. Moreover, the study establishes a clear correlation between the concept of nature-based solutions and the imperative to leverage the potential of nature to effectively address environmental challenges and achieve socio-economic advantages. In addition, the study explores the role of geography in effectively addressing the opportunities and challenges associated with urban green spaces in Uzbekistan. Policymakers, researchers, and practitioners engaged in promoting sustainable urban development can draw valuable insights from this study. The findings underscore the critical importance of adopting a multidimensional approach to urban planning to foster the development of sustainable and livable cities. By implementing the recommendations outlined in this study, Uzbekistan has the potential to enhance its green spaces and successfully tackle pressing environmental challenges. Consequently, this study fills a significant research gap by highlighting the pivotal role of geography in comprehending and addressing the importance of urban green spaces. The findings align with the concepts of nature-based solutions and geography, offering actionable guidance for sustainable urban development in Uzbekistan.

NBS impacts and implications

This article highlights the impacts and consequences of nature-based solutions (NBS) in the context of green spaces in Uzbekistan. By integrating NBS principles into urban planning and design, Uzbekistan has the potential to achieve significant environmental, social, and economic benefits.

1) Environmental Impacts:

- *Pollution reduction*: green spaces help reduce air and noise pollution in urban areas, improving overall environmental quality.
- *Biodiversity conservation*: strategic placement and maintenance of green spaces promotes habitat connectivity and supports biodiversity, improving ecosystem resilience.

- *Climate change adaptation*: green spaces help mitigate the impacts of climate change by reducing the urban heat island effect, protecting against extreme weather events, and improving carbon sequestration.

2) Social Impacts:

- *Improved health and well-being*: Accessible and well-designed green spaces have a positive impact on physical and mental well-being and provide opportunities for recreation, relaxation, and stress reduction.
- *Social cohesion*: green spaces serve as gathering places for communities, promoting social interactions and a sense of belonging and inclusion.
- *Equity and Accessibility*: integrating green spaces into urban areas ensures equal access for all residents, eliminates social inequities, and promotes environmental justice.

^{*} Corresponding author.

E-mail address: 198928@jnu.ac.kr (Z. Juraev).

<https://doi.org/10.1016/j.nbsj.2023.100077>

Available online 10 July 2023

2772-4115/© 2023 The Author(s). Published by Elsevier Inc. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

3) Economic Implications:

- *Green job creation*: The development and maintenance of green spaces creates employment opportunities, particularly in areas such as landscaping, maintenance, and ecotourism.
- *Economic resilience*: green spaces contribute to the attractiveness of cities, attract investment and tourism, and increase property values, supporting long-term economic growth.

4) Implications:

The findings of this study have important implications for policy-makers, urban planners, and practitioners working on sustainable urban development in Uzbekistan. Integrating NBS principles into urban green space planning and management can guide decision-making processes, leading to the following implications:

5) Policy and planning:

Incorporate NBS principles into urban planning policies and regulations to ensure the integration of green spaces and promote sustainable land use.

Prioritize the protection, restoration, and expansion of green spaces, considering their multifunctional benefits and long-term sustainability.

6) Community Involvement:

Involve local communities in the planning, design, and management of green spaces, fostering a sense of ownership and social cohesion.

Recognize the specific needs and perspectives of diverse communities and ensure inclusive access to green space.

7) Collaboration and Partnerships:

Promote collaboration between the public and private sectors, academia, and civil society organizations to leverage resources and expertise for effective implementation of NBS in green space development.

Strengthen cross-sector collaboration, particularly between agriculture, water, soil, and nature conservation, to improve the sustainability and integrity of green spaces.

By considering these impacts and implications of NBS in the context of green spaces, Uzbekistan can pave the way for a more sustainable and livable future that benefits both its environment and its communities.

Introduction

In recent times, there has been a growing acknowledgement of the significance and design considerations associated with green spaces in urban planning. This heightened awareness stems from concerns surrounding climate change and the pressing need for sustainable development [1–3]. Urban green spaces play a crucial role in fostering healthy and sustainable urban environments [4]. Governments across the globe have increasingly recognized the significance of green spaces in promoting environmental sustainability, economic prosperity, and public health. Numerous studies have consistently shown the positive impact of urban green spaces on physical and mental well-being, overall life satisfaction, and quality of life [5]. However, the rapid pace of urbanization and urban sprawl has resulted in a substantial reduction in the availability and size of green spaces [6,7]. Addressing the complex challenges associated with green spaces requires a comprehensive approach that considers rapid urbanization, environmental concerns, and urban development. In Uzbekistan, green spaces encompass a variety of natural elements such as forests, parks, gardens, street trees, riparian plantings, and riparian groves. These green spaces serve multiple purposes, including providing respite from the summer heat [8], improving air quality in densely populated cities [9], and reducing noise pollution in residential areas. However, the rapid pace of urban

development has intensified the negative impacts on green spaces [10], making the provision of urban green spaces a pressing concern in the country.

Despite their significance, there has been limited research conducted by Uzbek geographers on green spaces [11–13]. This study aims to bridge this gap by analyzing existing data to gain insights into the spatial distribution of green spaces in Uzbekistan. Moreover, it emphasizes the central role of geography in developing effective strategies and solutions for green spaces. By addressing this research gap, the study seeks to contribute to the understanding and promotion of green spaces in Uzbekistan. Furthermore, this study highlights the potential contribution of geographers to solving this problem. This study integrates various theoretical perspectives and approaches from different disciplines to improve the understanding and management of green spaces in Uzbekistan. One relevant theory in urban geography is urban green network theory, which emphasizes the creation of interconnected green spaces through the establishment of greenways, green corridors, and wildlife corridors ([14,15]; Forest Research). By strategically planning and integrating these green networks into cities, Uzbekistan can promote biodiversity, facilitate wildlife movement, and improve overall environmental sustainability [16].

Integrating nature-based solutions (NBS) into urban green spaces is critical to addressing the challenges facing Uzbekistan. Nature-based solutions use natural and ecological processes to strengthen a system's ability to deal with multiple, interconnected challenges. Uzbekistan has the opportunity to enhance its resilience to climate change, preserve biodiversity, mitigate disaster risks, and promote sustainable urban development by implementing nature-based solutions (NBS). One effective NBS measure is the establishment of green spaces, urban parks, and wildlife corridors. These initiatives can provide numerous benefits such as temperature regulation, carbon sequestration, improved air quality, and enhanced habitat connectivity for wildlife [17]. By integrating NBS measures into urban planning and development strategies, Uzbekistan can create healthier and more sustainable cities while addressing pressing environmental challenges. These actions are consistent with the principles of the NBS, which emphasize an equal reliance on social, environmental, and economic pillars for holistic and sustainable solutions. This study emphasizes the significance of geography and advocates for the integration of multidisciplinary approaches to prioritize and allocate resources towards green spaces. By doing so, it aligns with the concept of nature-based solutions and underscores the importance of enhancing the well-being and overall quality of life for urban residents not only in Uzbekistan but also in other regions. Considering the current context of climate change and rapid urbanization, the significance of green spaces and their integration into nature-based solutions cannot be underestimated. The inclusion of urban green spaces, designed and implemented in line with nature-based solutions, plays a vital role in establishing a sustainable and thriving urban environment. Additionally, this study presents a pertinent historical illustration of green spaces in Uzbekistan, emphasizing the necessity to conserve and advance these areas in the face of contemporary environmental challenges. By underscoring the importance of geography and geographers in formulating effective strategies and solutions, this study seeks to inspire and guide endeavors aimed at preserving and enhancing green spaces alongside nature-based solutions [2], ultimately benefiting urban residents in Uzbekistan and beyond.

Theoretical background

Urban geography plays a central role in understanding the historical legacy of green spaces in Uzbekistan and addressing the multiple environmental challenges facing urban areas [12]. Green spaces, including parks, gardens, and forests, are indispensable components of Uzbekistan's urban fabric and provide social, environmental, and cultural benefits to residents [18]. However, the rapid pace of urbanization, rapid population growth, and various environmental factors pose

significant obstacles to the preservation and expansion of green spaces [19,20]. These spaces contribute significantly to the well-being of urban residents by providing opportunities for recreation, relaxation, and social interaction [21,22]. They also play a critical role in mitigating environmental problems such as air pollution, heat island effects, and water runoff while supporting biodiversity and ecosystem services [23, 24]. To comprehensively address the issue of green spaces in Uzbekistan, the integration of different theoretical perspectives and approaches is required. Urban green network theory emerges as an invaluable conceptual framework for addressing these challenges. This theory emphasizes the creation of interconnected green spaces, such as green corridors, greenways, and wildlife corridors, that are strategically integrated into urban areas. With this approach, Uzbekistan can promote biodiversity, facilitate wildlife movement, and improve overall ecological resilience [16]. Furthermore, integrating an ecofeminist approach can provide insightful perspectives on the issues surrounding green spaces in Uzbekistan. Ecofeminism recognizes the connection between gender, nature, and social justice and advocates for inclusive and equitable approaches to environmental protection [25]. By applying an ecofeminist perspective, Uzbekistan can ensure that the design and management of green spaces give due consideration to the diverse needs and perspectives of communities, thereby promoting gender equality, social inclusion, and environmental sustainability [26]. The theoretical framework of this study emphasizes the crucial role of urban geography in comprehending the historical heritage of green spaces in Uzbekistan and effectively addressing the current environmental challenges in urban areas. Therefore, this interdisciplinary approach is of utmost importance for creating sustainable and livable urban environments that prioritize the well-being of residents while preserving the ecological integrity of Uzbek cities.

Historical gardens, such as the gardens of Emperor Amir Timur in Uzbekistan, serve as invaluable repositories of knowledge when viewed through the lens of historical geography. These gardens offer deep insights into the intricate interplay between human societies, their environments, and the spatial configuration of cities. By exploring the historical context that shaped Timur's gardens and learning from analogous precedents, we can develop effective solutions to contemporary green space problems in Uzbekistan and throughout the region. Thus, to address these green space problems, it is essential to incorporate the principles and theories of urban geography that provide a solid foundation for understanding and addressing these challenges.

The theory of central places, developed by Walter Christaller [27], provides insight into the distribution patterns and functional roles of urban centers within a given geographic area. Applying this theory to Uzbekistan, areas with a lack of adequate green space can be identified, and optimal locations for establishing new central places that function as green hubs can be determined [28]. These focal points would offer vital services and facilities while seamlessly incorporating thoughtfully designed green spaces that enhance residents' quality of life. Urban ecology, pioneered by Robert Park and Ernest Burgess [29], investigates the intricate interplay between human activities and the natural environment in urban areas [30]. By integrating the principles of urban ecology, policymakers can analyze the spatial distribution of green spaces in Uzbekistan's urban environments and identify strategic opportunities for expansion or restoration [31]. Such an approach promotes the conservation of pristine natural habitats, increases biodiversity, and ensures the provision of vital ecosystem services within the urban matrix. The principles of humanistic geography, as advocated by Yi-Fu Tuan [32], emphasize the significant role of human experience and emotion in shaping urban spaces. By incorporating humanistic perspectives, policy makers can design green spaces that meet the diverse needs and desires of residents [33,32]. Active community involvement in the planning and design process fosters a sense of ownership and strengthens social cohesion, creating an inclusive and dynamic urban environment [34]. The political economy of cities, studied in depth by Manuel Castells, decodes the complex interplay of

political, economic, and social factors that influence urban development. Applying the principles of the political economy of cities to green spaces in Uzbekistan allows policymakers to analyze the power dynamics and economic forces that influence the creation and maintenance of such spaces. By advocating for equitable access to green spaces and incorporating sustainability considerations into urban planning, policymakers can promote cities that are both environmentally and economically resilient [34,35]. Therefore, by integrating these advanced theoretical perspectives and approaches, policymakers can develop informed strategies to preserve and enhance green spaces in Uzbekistan. This coherent and interdisciplinary approach, combining urban geography, historical analysis, and theoretical frameworks, enables the creation of sustainable urban environments that prioritize the well-being of residents and preserve Uzbekistan's ecological heritage.

Methodology

The methodology integrates geographic theories and concepts with urban geography and other relevant disciplines to achieve a comprehensive understanding of the topic. To establish the link between green spaces and the historical heritage of Uzbekistan, extensive literature research and review of historical documents were conducted, with particular attention to examples such as the gardens of Amir Timur. The analysis included a careful review of scholarly articles, books, and studies dealing with cultural traditions and practices related to green spaces in Uzbekistan. The goal was to make a scientifically sound proposal for green spaces that would be applicable and useful in the Uzbek context, both historically and in the present. In addition, this approach aimed to trace the evolution of green spaces over time in the geographical context and to understand their importance for the urban environment. The research also addressed current environmental challenges facing Uzbekistan's cities. Quantitative data on urbanization trends, illegal tree cutting, energy and waste management systems, and climate change impacts were gathered from a variety of sources, including government reports, international and national statistical databases, and relevant scientific publications. A thematic approach was used in the data analysis to identify key themes and patterns related to the historical legacy of green spaces and existing environmental challenges. These themes were then examined through the lens of geographic theories, specifically urban green network theory, which guided the interpretation of the results. By integrating geographic theories, a deeper understanding of the spatial dynamics, ecological relationships, and social dimensions of green spaces in Uzbekistan was achieved.

It is important to acknowledge the limitations that were encountered during the research process. A notable limitation was the lack of comprehensive data on the distribution of trees and the extent of green space in Uzbekistan. This limitation hindered the ability to make an in-depth assessment of the current status of green spaces. Despite these limitations, however, the study underscores the central role of geography in addressing green space issues in Uzbekistan. It highlights the need for comprehensive monitoring and geographic research to support sustainable land management and promote a green and healthy urban environment. By integrating findings from urban geography and other relevant disciplines, policymakers, and stakeholders can make informed decisions and implement effective strategies to maintain and improve green spaces in Uzbekistan. So, this methodological approach, which combines geographic theories, historical analysis, quantitative data, and qualitative perspectives, offers valuable insights into the historical legacy of green spaces in Uzbekistan and the current environmental challenges facing its cities. When the results are compared with the discussions and conclusions presented in this article, it becomes clear that an interdisciplinary and geographically oriented approach is critical for addressing green space issues and promoting sustainable urban development in Uzbekistan.

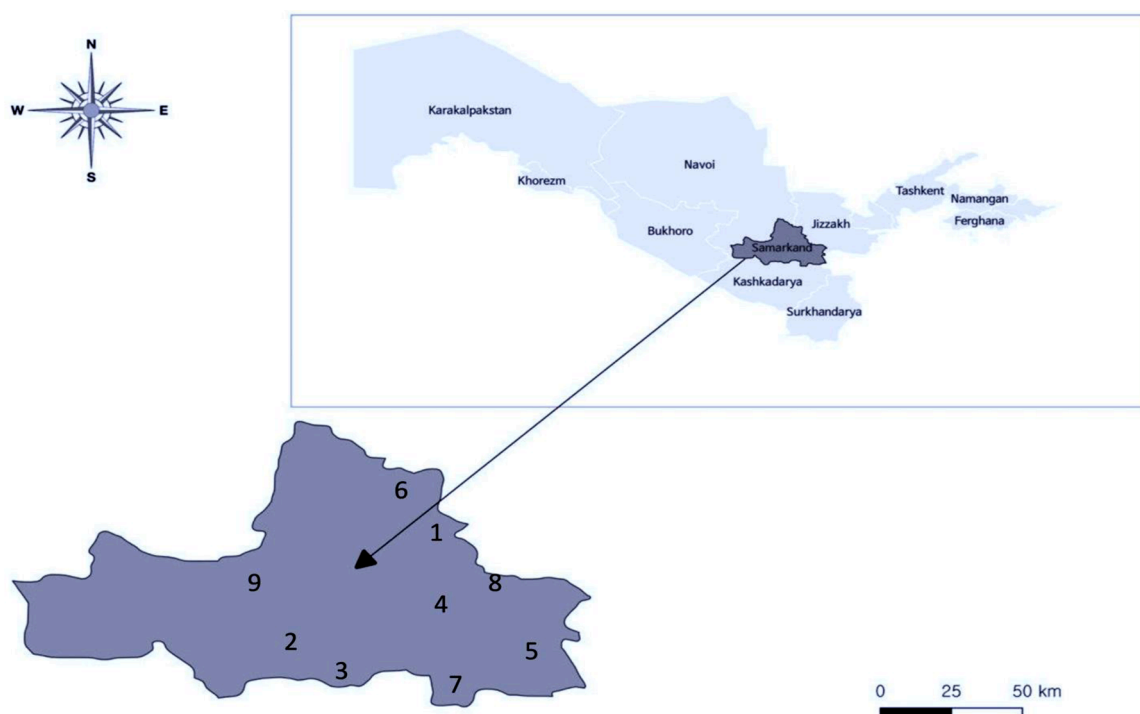


Fig. 1. Location of Emperor Timur's Gardens in Samarkand.¹¹ (Source: [12]). Note: The author developed the map, which shows an actual map of Uzbekistan and indicates Samarkand province. The numbers on the map of Samarkand indicate the approximate geographic location of Timur's Gardens.

Traditional gardens in Uzbekistan: a historical geography perspective

The interrelationship between geography and history becomes clear when we analyze how geographic features affect a particular place. In the context of Uzbekistan, this study examines the gardens attributed to Emperor Amir Timur (also known as Tamerlane, 1336–1405) as a compelling historical example of the link between historical geography and urban green space. Emperor Timur, who was known for his urban planning initiatives, placed great emphasis on landscape architecture and territorial expansion [36]. The capital of his empire, Samarkand, located in present-day Uzbekistan, serves as an exceptional case study (Fig. 1). Emperor Timur believed that the city's surroundings should reflect the power and greatness of his empire. To achieve this, numerous gardens were created in and around Samarkand, with experienced experts in architecture and greenery guiding the design [12,37]. These gardens included both rectangular and non-geometric types. The rectangular gardens, located on the outskirts of the city, had geometric patterns and were divided into four sections by flowing ditches. These gardens served as ceremonial spaces and entrances for important events and contributed to the city's green belt while providing access to natural spaces for residents and visitors [38]. The historical gardens of Emperor Amir Timur are a vivid example of the relationship between place and spatial planning in a geographical context ([39]; see also, [12]).

Throughout history, the creation of green spaces has been a symbol of the cultural, scientific, and agricultural progress of civilizations [40]. Emperor Timur's gardens demonstrate the integration of these elements and offer valuable insights into the spatiality of gardens and their profound influence on urban planning. In particular, the separation of residential areas and green spaces in Amir Timur's gardens illustrates the importance of coordinating green spaces and housing in contemporary urban planning. This aspect is crucial in addressing the challenges of urban densification, where green spaces are often compromised. Lessons from Amir Timur's gardens highlight the need for effective management and collaboration among experts to create thriving cities and green spaces. Geography, with its focus on place and

time, plays a central role in understanding and applying these principles. The study also suggests the application of historical geography to current urban and regional planning initiatives through the use of geographic methods and analysis, such as Geographic Information Systems [41]. By studying historical change, hypotheses can be formulated and applied in modern contexts to improve urban well-being and sustainability. In addition to historical geography, there are several theories of urban geography that play a role in the context of Emperor Timur's gardens [42]. One relevant theoretical framework is the concept of an urban green space network, which emphasizes the interconnectedness and availability of green spaces throughout a city. Timur's gardens exemplify the creation of a green belt surrounding the city, ensuring that residents have access to nature regardless of their location. This approach aligns with urban spatial structure theories that advocate for strategically integrating green spaces to enhance the overall well-being of urban dwellers. Another pertinent theory in this context is "ecological urbanism" [43], which highlights the integration of nature and the urban environment to foster sustainable and resilient cities [44,45]. Emperor Tamerlan's gardens show a harmonious relationship between man-made structures, natural elements and the preservation of flora and fauna [42]. The conservation and careful management of these gardens embody the principles of ecological urbanism that can be applied in contemporary urban planning to create greener and more livable cities. In the broader context of Asia's diverse human and physical geographies, this study of Emperor Timur's gardens offers unique insights into the historical development and spatial organization of urban green spaces in Uzbekistan. It illuminates the cultural, social, and ecological significance of gardens in shaping the urban landscape.

The historical context of gardens in Uzbekistan fits into the broader Asian context in which green spaces have played a central role in urban development, esthetics, and cultural practices of various civilizations. The study of "Timur's Gardens" is consistent with the perspectives of urban geographers who emphasize the importance of green spaces in improving the quality of life in cities. Urban geographers recognize the multifunctionality of green spaces in providing recreational opportunities, improving air quality, mitigating the urban heat island effect,

Table A1
Provincial distribution of forested lands in Uzbekistan.

Provinces	Total Area of the region (km ²)	State Forest Fund areas (ha, thousands)	Protected natural areas (ha, thousands)
Karakalpakstan	161,358	5752.70	2589.6
Khorezm	6464	87.9	21.7
Bukhara	41,937	623.9	26.8
Navoi	109,375	3098.20	0.0
Samarkand	16,773	57.9	2.4
Kashkadarya	28,568	330.2	82.9
Surkhandarya	20,099	325	23.8
Jizzakh	21,179	291	68.3
Syrdarya	4276	8.8	0.0
Tashkent	15,258	538	642.3
Namangan	7181	126.7	0.0
Fergana	7005	15.9	0.0
Andijan	4303	8	0.0
Total:	11,264.20	11,264.20	3457.8

Sources: World Bank Data, Statistics agency under the president of Uzbekistan & State Committee for Forestry of Uzbekistan (data of 2017, 2020, and 2021).

Geographic examination of current green space issues

Analysis of the urban geography of Uzbekistan reveals several important aspects. As a landlocked country with a land area of 425,400 km² and 444,103 km², Uzbekistan is characterized by diverse geographical features. The population, which is about 35 million in 2021, is concentrated in both urban and rural areas, with about 49 percent living in rural areas (Statistical Agency under the President of Uzbekistan). This distribution reflects the country's dependence on agriculture, which accounts for a large portion of the economy. The country's topography consists largely of lowlands and plains, including the Aral Sea basin in the north and west (Republic of Karakalpakstan) and the vast Kyzylkum Desert in the south (Navoi Province). In eastern Uzbekistan, however, there are mountainous regions such as the Gissar Mountains (Kashkadarya Province and Amudarya River Basin), which are up to 4600 m above sea level. The fertile and irrigated Fergana Valley, surrounded by mountain ranges, is an exception to the low population density found in most rural areas. Uzbekistan has a continental climate, ranging from warm continental in the Fergana Valley to

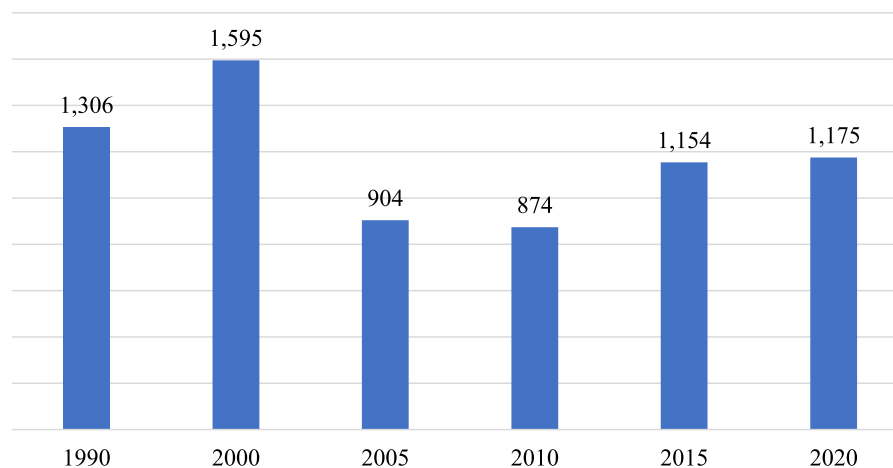


Fig. A2. Area covered by timbers (Source: FAO, 2020).

promoting biodiversity, and contributing to overall well-being. The gardens of great emperor Tamerlane exemplify these benefits and highlight the importance of integrating green spaces into urban planning to promote sustainable and vibrant cities. The historic gardens of Emperor Timur (Tamerlane) in Uzbekistan serve as a compelling lens through which we can analyze the interplay between historical geography, urban green spaces, and spatial planning. Valuable lessons can be learned from these gardens that can also be applied to the challenges of our time, such as the need for effective management of green spaces in the midst of urban densification. By drawing on historical geography and relevant theories of urban geography, we gain insights into the importance of green space networks, ecological urbanism, and the cultural significance of gardens. Applying geographic methods and analysis to historical contexts facilitates the formulation of hypotheses that can be applied to modern urban and regional planning initiatives, ultimately contributing to improved urban well-being and sustainability.

¹ The gardens were built by the special order of Emperor Timur, and located in Timuride Empire Capital city Samarkand (1370–1405): N1 – High Garden, N2 – Garden of Paradise, N3 – Garden called “Davlatobod”, N4 – “Enchanting” Garden, N5 – Garden called “Mirror of the World”, N6 – Garden of “Maydon”, N7 – New Garden, N8 – Maple Garden, N9 – Garden of the Wind (Sources: [12]; see also, [54]).

cold semi-arid in the western regions, where a cold desert climate prevails (Ministry of Ecology, Environmental Protection and Climate Change of Uzbekistan).

Average temperatures in January range from +4 °C in the south to –10 °C in the north, while in July they range from +27 °C in the north to +37 °C in the south. Summers are long, extremely dry, and hot, with little precipitation. However, precipitation increases with altitude in the east and southeast, reaching up to 800–900 mm on the slopes of the western Tian Shan and Pamir Alai (Fergana, Namangan and Andijon provinces). The irregular terrain can lead to soil erosion and river silting during heavy summer rains (UZHYDROMET; World Bank Data).

Climate change poses a significant threat to the sustainable development of Uzbekistan. Rising temperatures, droughts, and extreme weather events are already being observed. These changes may negatively impact the country's ecosystems, including its barren forests and woodlands (Annex 1, Table 1). Given the vulnerability of ecosystems to anthropogenic factors and climatic events, early planning of environmental activities focused on sustainable management and restoration of the landscape is critical to maintaining the country's biosphere and its beneficial functions (UNEP). Uzbekistan has an average population density of 74 persons per square kilometer, and its population has grown at an annual rate of 1.4 to 2.9 percent from 1990 to 2018. The country has about 25.5 million hectares of agricultural land, much of which is used to grow cotton, followed by wheat and other cereals (Statistical Agency under the President of Uzbekistan).

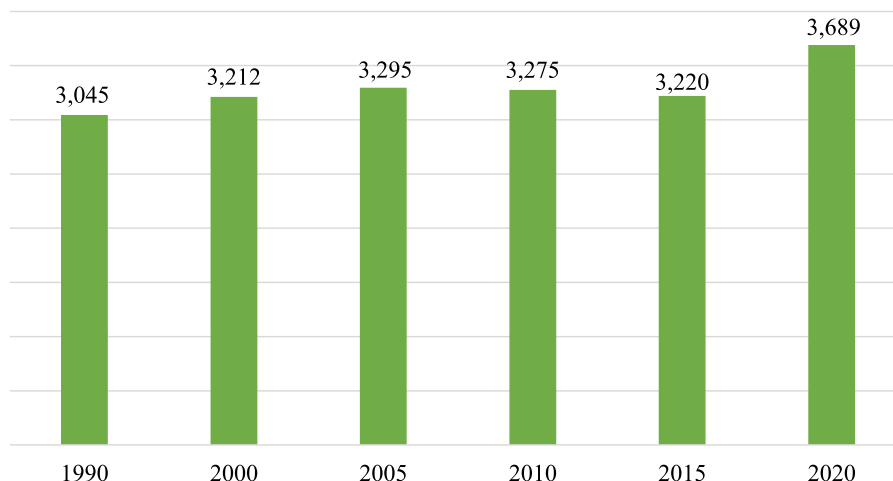


Fig. A3. Area covered by forest (Source: FAO, 2020).

In terms of forest cover, Uzbekistan is considered a forest-poor country, with only about 7.2 to 7.5 percent of the land area covered by forests (FAO). The State Forestry Fund covers most of the forested area, about 11.9 million hectares (State Committee of Forestry of Uzbekistan). Forests in Uzbekistan play a critical role in combating desertification, protecting against soil erosion and flooding, and mitigating the effects of dust storms and dry winds (UZHYDROMET). However, the remaining natural forests are under pressure from a variety of factors, including overgrazing, increasing demand for fuelwood, unsustainable land use practices, wildfires, and climate hazards. Only a small portion of state forest fund land is dedicated to timber and fuelwood production, while one-third is used for protected areas and biodiversity conservation, mainly for non-timber forest products (see also [Appendix: Figs. A2 and A3](#)).

Given the dry climate of the country, the category of other forested land in Uzbekistan is also important. Forested land has changed over time, including the inclusion of agricultural land in the State Forest Fund and the transfer of land with forested parcels. These changes have contributed to variations in forested acreage and overall forest cover. Looking at the geographic and climatic conditions of Uzbekistan, the urban geography of the country is influenced by a combination of lowlands, mountains, deserts, and fertile valleys. Despite their limited extent, the country's forests play an important role in preserving the environment and promoting sustainable development. Efforts to manage and restore landscapes, considering the impacts of climate change, will be critical to the future well-being of Uzbekistan and its people (FAO).

Land classification in Uzbekistan plays an important role in shaping the urban landscape and managing natural resources. The 1998 Land Code divides land into eight categories, including state forest land, agricultural land, reserve land, private land, industrial land, recreational land, cultural and architectural heritage land, and water areas. This classification reflects Uzbekistan's diverse geographic features, ranging from forests and agricultural lands to deserts and water bodies. Forestry activities in Uzbekistan focus on afforestation in the desert zone, particularly in the Aral Sea area, to combat salt and dust erosion and stabilize shifting sands. Forests also serve as protective barriers around oases, industrial sites, railroads, roads, and pipelines, mitigating the effects of dust storms, dry winds, and other natural phenomena. The main function of forests in Uzbekistan is to combat desertification, reduce flood risk, and prevent soil erosion. They also contribute to the conservation of biodiversity and wildlife.

Protected areas play a crucial role in preserving Uzbekistan's natural ecosystems and promoting sustainable development. The country has established nature reserves, national nature parks, wildlife reserves, and protected landscapes, among others ([Appendix, Table A1](#)). These areas occupy about 4.7 percent of Uzbekistan's total land area. Most nature

reserves and some wildlife sanctuaries are overseen by the State Committee for Ecology and Environmental Protection of Uzbekistan, while the State Committee for Forestry manages national nature parks and other protected areas (State Committee for Forestry of Uzbekistan; World Bank Data). Most of the protected areas and forests are located in mountainous regions, which emphasizes the importance of these areas for biodiversity conservation. Management of forests and natural resources is the responsibility of state enterprises, including state forest enterprises. State forest enterprises have territorial responsibilities at the district level and manage the State Forest Fund, which covers about 11.2 million hectares of land. The forestry program implemented in Uzbekistan aims to plant forests, especially in arid areas and the Aral Sea region, to protect soil and water, preserve biodiversity, and promote natural regeneration. Uzbekistan's urban geography is thus shaped by its diverse land classification, with forests and protected areas playing a critical role in preserving the environment, combating desertification, and reducing the impact of natural hazards. Managing and conserving these resources requires coordination among various agencies and the implementation of sustainable practices to ensure the long-term well-being of urban areas and the country as a whole.

Uzbekistan faces challenges related to illegal tree cutting, particularly in the desert and riparian forest regions. The scarcity of forest and tree resources exacerbates the problem, as people rely heavily on these resources for firewood and local timber. Continuous extraction of fuelwood has led to the gradual degradation of natural saxaul forests in desert areas, while illegal logging has significantly affected poplar forests in riparian areas over the past two decades (State Committee of Forestry of Uzbekistan). In the eastern mountainous regions of the country, there are reports of unregulated charcoal production and illegal logging, particularly affecting the natural juniper forests (World Bank Data). However, compared to forest-rich countries, the problem of illegal logging in Uzbekistan is relatively inconspicuous. To curb illegal logging, a combination of effective law enforcement, promotion of alternative activities for sustainable fuelwood and charcoal production, and use of alternative energy sources is needed [46].

Unfortunately, limited data make it difficult to make a realistic assessment of the extent of unrecorded logging and its potential impact on forest degradation. In addition to illegal logging by external actors, there is also the possibility that valuable walnut, poplar, or juniper trees are falsely declared as sanitary wood to legally justify their logging. However, in the absence of reports of such incidents, it is difficult to assess their extent. In addition, illegal logging of walnut tubers may still occur in certain cases. Although there is no evidence of significant illegal logging in Uzbekistan, the country needs to address the problems associated with illegal logging in order to protect its limited forest and tree resources. Implementing sound law enforcement measures, promoting

sustainable alternatives to firewood and charcoal production, and exploring alternative energy sources are critical steps to mitigating the problem. In this way, Uzbekistan can protect its urban and rural landscapes, promote environmental sustainability, and ensure the availability of vital resources for its people.

In Uzbekistan, the forestry sector primarily focuses on protection and restoration rather than incongruent practices between industrial forestry and conservation. Cross-sectoral cooperation with agriculture, water, soil, and nature conservation is generally positive and does not pose significant problems for forest integrity. Historical deforestation and large-scale degradation of natural forests and shrublands have occurred, but conflicts mainly arise from excessive grazing by livestock (UNEP). The main challenge today lies in the severe degradation of many areas, necessitating an integrated landscape approach that incorporates diverse land uses. The agriculture, forestry, and fisheries sectors contribute between 25 and 29 percent of Uzbekistan's GDP, depending on the data. No specific annual harvest level is set for production forests, as all harvests are conducted for health reasons. Official annual harvests in recent years have amounted to 36,000 m³, and local production of sawn timber is approximately 26,000 m³ per year. Estimates suggest that the total stock of all forests and species combined ranges from 30 to 60 million m³ [46]. While figures on forest area, biomass, and increment are based on estimates and require verification, it can be noted that increment is either increasing or relatively stable across all forest types. Forests with mountain juniper (*Juniperus*) and riparian forests stocked with *Populus densifolia* (poplar) exhibit relative stability in terms of stocking.

The manufacturing of wood and cork products, excluding furniture, has seen significant growth in recent years. Furniture manufacturing and paper production have also experienced notable increases. Wood for industrial purposes is predominantly imported from other countries. Domestic timber from state forests, consisting of deciduous trees and junipers, can only be harvested through sanitary logging by state forest enterprises, amounting to around 5000 m³ per year (Statistical Office of the President of Uzbekistan). State forest enterprises also supply smaller quantities of firewood, but the official figure of approximately 18,000 m³ underestimates the demand for energy wood (FAO; World Bank Data). In rural areas, where regular power outages pose a risk, households rely partially on firewood for cooking and heating. The official data indicate that 72 percent of total wood production is used as firewood. However, the actual demand and consumption of fuelwood and charcoal are likely higher, potentially exceeding 1–2 million m³. Unrecorded logging for fuelwood and charcoal is widespread across all biomes of the country.

Climate change significantly affects Uzbekistan, impacting all sectors of the economy, including land use, agriculture, water management, biodiversity, and forests. Changing climatic conditions and increased vulnerability pose challenges to forests and woodlands, particularly in terms of physiological health, fire susceptibility, and other factors that reduce photosynthesis, increase salinity, and alter environmental conditions. Processes of land degradation and desertification are intensified by climate change, affecting the productivity, biodiversity, and environmental services of landscapes, particularly in the Aral Sea region, the Kyzylkum Desert, and mountain forests and submontane areas. Global climate change plays a critical role in increasing the risk of forest degradation and biodiversity loss. However, limited information is available on how forests can adapt and enhance resilience to mitigate human and ecosystem vulnerability to climate change (UNFCCC).

Intersection of the green areas of Uzbekistan

The convergence of urban green spaces and nature-based solutions in Uzbekistan represents a promising way to address environmental challenges while promoting sustainable and resilient cities. Urban green spaces, such as parks, gardens, and forests, provide a variety of benefits to city residents, including opportunities for recreation, social

interaction, and cultural enrichment. In addition, these green spaces play a critical role in mitigating environmental problems such as air pollution, heat island effects, and water runoff, while supporting biodiversity and ecosystem services. Nature-based solutions have emerged as a conceptual framework for effectively managing natural systems to comprehensively address environmental, social, and economic challenges. "Nature-based solutions" measures involve harmonizing with nature to provide sustainable and cost-effective solutions that benefit both human well-being and the environment [47,48]. In the context of Uzbekistan's urban green spaces, the integration of "nature-based solutions" measures has the potential to improve their ecological value, functionality, and resilience.

The International Union for Conservation of Nature has proposed criteria for classifying green/blue interventions as "Nature-based solutions" measures, which include elements such as promoting biodiversity, addressing societal challenges, ensuring economic viability, implementing adaptive management, and landscape-level implementation. By incorporating these criteria into the planning, design, and management of urban green spaces, Uzbekistan can align its efforts with the guiding principles of "nature-based solutions" (also refer to [48]). For example, incorporating urban green network theory into green space development can result in interconnected systems that include green corridors, greenways, and wildlife corridors that promote biodiversity, facilitate wildlife movement, and strengthen overall ecological resilience (also, refer to [49]). These green networks are not only ecologically beneficial, but also help address societal challenges such as improving public health and well-being, promoting social cohesion, and improving the quality of life in cities. In addition, an ecofeminist approach can provide invaluable insights into the design and management of green spaces in Uzbekistan, ensuring their inclusivity, equity, and social justice. By recognizing the complex interconnections between gender, nature, and social justice, an ecofeminist perspective can inform the development of green spaces that meet the diverse needs and perspectives of communities (see also: [50]). This approach is consistent with "nature-based solutions" principles that emphasize equitable trade-offs and the integration of inclusive governance processes.

Incorporating the principles and theories of urban ecology can further strengthen the integration of "nature-based solutions" measures into urban green spaces (e.g., [51]). By understanding the complex relationships between human activities and the physical environment, policymakers can delineate spatial patterns of green space, identify areas with inadequate green infrastructure, and pinpoint opportune moments for expansion or restoration. This approach not only supports the conservation of natural habitats but also enriches biodiversity and provides vital ecosystem services in urban landscapes. In addition, the principles of humanistic geography emphasize the importance of considering human experiences and emotions when designing urban spaces (e.g., [52,53]). By actively involving the community in the planning and design process, policymakers can instill a sense of ownership, strengthen social cohesion, and create an inclusive and vibrant urban environment. This participatory approach is consistent with "nature-based solutions" principles that emphasize stakeholder engagement and integration of diverse perspectives.

Addressing the political economy of cities in the context of green spaces in Uzbekistan allows policymakers to analyze the power dynamics and economic forces underlying the creation and maintenance of these spaces. By advocating for equitable access to green spaces and incorporating sustainability considerations into urban planning, policymakers can promote environmentally and economically resilient cities. This is consistent with NBS principles that emphasize economic viability and the trade-offs associated with green infrastructure projects. When these advanced theoretical perspectives and approaches are incorporated into the planning, design, and management of urban green spaces in Uzbekistan, policymakers can develop informed strategies to conserve and enhance these spaces while adhering to the principles and goals of "nature-based solutions". This overlap between urban green

spaces and “nature-based solutions” measures provides a holistic and integrated approach to addressing environmental challenges, promoting sustainable urban development, and preserving Uzbekistan’s ecological heritage to ensure the well-being of its residents.

Discussion

Understanding the complicated relationship between geography and the challenges posed by green spaces in Uzbekistan is critical to developing effective solutions. This study has examined various theoretical concepts, historical gardens, and the current context to gain valuable insights into population distribution, forest management, climate change, protected areas, illegal logging, and urban geography in Uzbekistan. These insights serve as the basis for the following discussion topics, which make connections between specific geographic theories and approaches and the pressing issues surrounding green spaces:

First, population distribution plays an important role as Uzbekistan’s dependence on agriculture influences population structure. the theory of “agricultural geography” reveals spatial relationships between agriculture, population distribution, and land suitability. This theme suggests that rural areas with fertile land and access to water sources tend to have higher population densities. Applying central place theory helps identify areas lacking green space and create central places that integrate well-designed green space.

Second, forest management is a critical issue for Uzbekistan, considering its limited forest coverage and the risks associated with illegal logging and unsustainable land practices. Environmental geography provides valuable insights into the complex relationship between human activities and natural systems, including forests. Additionally, concepts derived from urban ecology contribute to understanding the distribution patterns of green spaces within urban areas, allowing for the identification of potential areas for expansion or restoration.

Third, climate change presents challenges such as rising temperatures, droughts, and extreme weather events in Uzbekistan. Climatology studies climate patterns, their impacts, and strategies for adaptation and mitigation. Humanistic geography theory emphasizes the diverse needs and desires of local communities and promotes inclusive green space design and active community engagement.

Fourth, protected areas and national parks play a critical role in conserving Uzbekistan’s natural ecosystems. Conservation Geography focuses on the establishment and management of protected areas. Addressing the political economy of cities ensures equitable access to green spaces and integrates sustainability considerations into urban planning.

Fifth, the problem of illegal logging arises, particularly in the desert and riparian forest regions of Uzbekistan. Resource geography studies the extraction, use, and management of natural resources. Urban ecology and the political economy of cities offer insights into the spatial patterns of green spaces and the economic forces that drive illegal logging.

Finally, urban geography covers various land categories in Uzbekistan, with forests playing a critical role in environmental protection. Urban geography analyzes the spatial organization and dynamics of urban areas. Central place theory guides the establishment of central places that integrate well-designed green spaces, while the principles of humanistic geography ensure that green spaces meet the diverse needs and desires of local communities.

These thematic discussions provide a comprehensive framework for addressing green space challenges in Uzbekistan by linking them to relevant geographic concepts and theories. By examining and considering these issues, policy makers can develop effective strategies to address green space challenges, protect natural ecosystems, mitigate climate change impacts, promote sustainable development, combat illegal logging, and manage various land classifications in urban areas. This interdisciplinary and geographically based approach is critical to creating sustainable and resilient urban environments that prioritize the

well-being of Uzbekistan’s residents and preserve the country’s ecological heritage.

Conclusion

Uzbekistan possesses substantial potential for the development of extensive green spaces through well-planned urban initiatives. The significance of urban green spaces cannot be underestimated, as they play a crucial role in mitigating pollution, noise, and vehicular emissions in cities, while also meeting the World Health Organization’s recommended minimum of “50 m² per person”. However, the establishment and maintenance of these green spaces necessitate significant investments, including the creation of green jobs, reduction of air pollution, integration of renewable energy sources, and enhancement of urban areas. The agricultural sector, as custodians of green spaces, must adopt sustainable practices to minimize soil and forest degradation. Comprehensive geographic studies that prioritize green spaces in urban areas are vital for sustainable land use planning. Future research should focus on understanding the spatial utilization of green spaces, identifying their users, and exploring appropriate strategies. These efforts will provide valuable insights into the challenges of green space management and its significance to urban life. The collection and analysis of geographic data in these studies will facilitate the identification of necessary actions for effective urban green space planning.

The implementation of transit-led development theory offers a relevant urban geography approach to addressing green spaces in Uzbekistan. By strategically locating green spaces near transportation hubs, Uzbekistan can establish accessible and interconnected networks of green spaces that promote sustainable mobility and enhance overall urban quality of life. Additionally, integrating an ecofeminist approach acknowledges the connection between gender, nature, and social justice. This approach ensures that green spaces are designed and managed to meet the specific needs and perspectives of diverse communities, promoting gender equality, social inclusion, and environmental sustainability.

Policymakers addressing green space concerns in Uzbekistan must consider key solutions from a geographic standpoint. Strategic integration of green spaces, guided by central place and urban ecology theories, ensures equitable access for all residents. By considering population density and proximity to residential areas, policymakers can foster a spatial distribution of green spaces that enhances well-being and quality of life in cities. Preserving and restoring natural urban habitats based on the principles of urban ecology should be a priority, encompassing the protection of existing green spaces, restoration of degraded areas, and creation of linkages between green corridors to promote biodiversity and ecosystem services. Involving local communities in the planning and design of green spaces, guided by humanistic geography principles, fosters a sense of ownership, community pride, and social cohesion. This participatory approach ensures that green spaces meet the specific needs and desires of residents, resulting in an inclusive and vibrant urban environment.

Considering urban political economy concepts, policymakers should advocate for sustainable urban policies that prioritize the development and maintenance of green spaces. This entails incorporating environmental considerations into urban planning, incentivizing the creation of green infrastructure, and fostering collaboration between the public and private sectors to achieve long-term sustainability and economic resilience. By drawing inspiration from traditional gardens within the context of historical geography and incorporating urban geography concepts and theories, policymakers can effectively address green space issues in Uzbekistan. Implementation of substantive solutions rooted in geography, such as strategic integration, conservation of natural habitats, community engagement, and sustainable urban policies, will pave the way for greener, more livable, and socially inclusive cities in Uzbekistan and beyond. Through concerted efforts and an unwavering commitment to sustainability, Uzbekistan can create a greener and more

prosperous future for its citizens, where green spaces seamlessly integrate into the urban fabric and promote environmental resilience, social equity, and human well-being. By implementing these approaches and implementing the recommended ideas and suggestions, Uzbekistan can enhance its green spaces, foster the development of sustainable and livable cities, and successfully address environmental challenges.

Declaration of Competing Interest

The authors declare no competing interests.

Data availability

No data was used for the research described in the article.

Acknowledgements

The authors would like to express their sincere gratitude to the editor and reviewers for their invaluable feedback and constructive comments, which greatly enhanced the quality and clarity of this manuscript. Their expertise and guidance have been instrumental in shaping this research and contributing to its scholarly rigor. The authors also acknowledge the efforts of the journal's editorial team for their support throughout the publication process.

No financial support was received for this research.

The research was conducted in an unbiased manner, and there are no financial or personal relationships that could have influenced the results or interpretation of the study.

This article is solely intended to provide objective analysis and insights into the historical heritage and urban environmental challenges associated with green spaces in Uzbekistan.

Supplementary materials

Supplementary material associated with this article can be found, in the online version, at [doi:10.1016/j.nbsj.2023.100077](https://doi.org/10.1016/j.nbsj.2023.100077).

Appendix

References

- [1] C.A. de Carvalho, M. Raposo, C. Pinto-Gomes, R. Matos, Native or exotic: a bibliographical review of the debate on ecological science methodologies: valuable lessons for urban green space design, *Land* 11 (8) (2022) 1201, <https://doi.org/10.3390/land11081201>. MDPI AG. Retrieved from.
- [2] K. Grunewald, T. Hu, L. Kümpel-Schlake, W. Hou, Q. Xu, et al., Towards 'green cities' fields of action and recommendations, in: K. Grunewald, et al. (Eds.), *Towards Green Cities. Cities and Nature*, Springer, 2018, https://doi.org/10.1007/978-3-319-58223-8_5.
- [3] L. Sturiale, A. Scuderi, The role of green infrastructures in urban planning for climate change adaptation, *Climate* 7 (10) (2019) 119.
- [4] T. Van Winkle, Z. Kotval-K, P. Machemer, Z. Kotval, Health and the urban environment: a bibliometric mapping of knowledge structure and trends, *Sustainability* 14 (19) (2022) 12320, <https://doi.org/10.3390/su141912320>. MDPI AG. Retrieved from.
- [5] R.F. Hunter, C. Cleland, A. Cleary, M. Droomers, B.W. Wheeler, D. Sinnett, M. Braubach, Environmental, health, wellbeing, social and equity effects of urban green space interventions: a meta-narrative evidence synthesis, *Environ. Int.* 130 (2019), 104923, <https://doi.org/10.1016/j.envint.2019.104923>.
- [6] M. Lerch, International migration and city growth in the global south: an analysis of IPUMS data for seven countries, 1992–2013, *Popul. Dev. Rev.* 46 (2020) 557–582, <https://doi.org/10.1111/padr.12344>.
- [7] Y. Xiao, G. Lan, Y. Ou, L. Zhang, J. Xia, Impact of urbanization on the spatial and temporal evolution of the water system pattern: a study of the Wuhan metropolitan area in China, *Ecol. Indic.* 153 (2023), 110408, <https://doi.org/10.1016/j.ecolind.2023.110408>.
- [8] T. Zupancic, The Impact of Green Space On Heat and Air Pollution in Urban Communities: A Meta-Narrative Systematic Review, David Suzuki Foundation, 2015, pp. 7–11. Retrieved from, www.davidsuzuki.org.
- [9] J.O. Anderson, J.G. Thundiyil, A. Stolbach, Clearing the air: a review of the effects of particulate matter air pollution on human health, *J. Med. Toxicol.* 8 (2012) 166–175, <https://doi.org/10.1007/s13181-011-0203-1>.
- [10] FAO, Guidelines on Urban and Peri-Urban Forestry, Food and Agriculture Organization of the United Nations, Rome, 2016. <https://www.fao.org/3/i6210e/i6210e.pdf>.
- [11] Aslanov, I., Mukhtorov, U., Mahsudov, R., Makhmudova, U., Alimova, S., Djuraeva, L., & Ibragimov, O. (2021). Applying remote sensing techniques to monitor green areas in Tashkent Uzbekistan. In *E3S Web of Conferences* (Vol. 258, p. 04012). EDP Sciences. [10.1051/e3sconf/202125804012](https://doi.org/10.1051/e3sconf/202125804012).
- [12] I. Rasulov, Z. Juraev, Urban green spaces – Uzbekistan's Case, *ISJ Theor. Appl. Sci.* 01 (117) (2023) 401–413, <https://doi.org/10.15863/TAS.2023.01.117.24>.
- [13] Z. Sharipjonova, A. Karimov, J. Mirzaqobulov, Monitoring city green zones using GIS technologies: an example of Tashkent city, Uzbekistan, in: *IOP Conference Series: Materials Science and Engineering* 883, IOP Publishing, 2020, 012083.
- [14] A. Tulisi, Urban Green Network Design: defining green network from an urban planning perspective, *TeMA J. Land Use Mobil. Environ.* 10 (2) (2017) 179–192.
- [15] N. Xiu, M. Ignatieva, C.K. van den Bosch, Y. Chai, F. Wang, T. Cui, F. Yang, A socio-ecological perspective of urban green networks: the Stockholm case, *Urban Ecosyst.* 20 (2017) 729–742, <https://doi.org/10.1007/s11252-017-0648-3>.
- [16] D. Vasiliev, S. Greenwood, Making green pledges support biodiversity: nature-based solution design can be informed by landscape ecology principles, *Land Use Policy* 117 (2022) 106–129.
- [17] S. Dhyani, S. Singh, M. Basu, R. Dasgupta, H. Santhanam, Blue-green infrastructure for addressing urban resilience and sustainability in the warming world, in: S. Dhyani, M. Basu, H. Santhanam, R. Dasgupta (Eds.), *Blue-Green Infrastructure Across Asian Countries*, Springer, Singapore, 2022, https://doi.org/10.1007/978-981-16-7128-9_1.
- [18] P. Edwards, A.D. Tsouros, Promoting Physical Activity and Active Living in Urban Environments: The Role of Local Governments, WHO Regional Office Europe, 2006, pp. 17–32.
- [19] J.A. Buxton, Attitudes Toward Green Infrastructure Strategies for More Livable and Sustainable Communities, 2018, p. 1219, <https://doi.org/10.7275/11944216.0>. Doctoral Dissertations.
- [20] C. Haaland, C.K. van Den Bosch, Challenges and strategies for urban green-space planning in cities undergoing densification: a review, *Urban Forest. Urban Green.* 14 (4) (2015) 760–771.
- [21] M. Rakhshandehroo, M.J. Mohd Yusof, O.M. Tahir, M.Y.M. Yunus, The social benefits of urban open green spaces: a literature review, *Manag. Res. Pract.* 7 (4) (2015) 60.
- [22] S.A. Salih, S. Ismail, Criteria for public open space enhancement to achieve social interaction: a review paper, *IOP Conf. Ser.* 291 (1) (2017), 012001, <https://doi.org/10.1088/1757-899X/291/1/012001>. IOP Publishing.
- [23] M. Ramaiah, R. Avtar, Urban green spaces and their need in cities of rapidly urbanizing India: a review, *Urban Sci.* 3 (3) (2019) 94.
- [24] T. Semeraro, A. Scarano, R. Buccolieri, A. Santino, E. Aarvevaara, Planning of urban green spaces: an ecological perspective on human benefits, *Land (Basel)* 10 (2) (2021) 105, <https://doi.org/10.3390/land10020105>. MDPI AG Retrieved from.
- [25] V. Shiva, M. Mies, Ecofeminism. Section Critique Influence Change, 2nd ed., Zed Books, Bloomsbury, 2014, pp. 278–301.
- [26] G. Gaard, Ecofeminism and climate change. *Women's Studies International Forum*, Pergamon, 2015, pp. 20–33. Vol. 49.
- [27] W. Christaller. Die zentralen Orte in Süddeutschland: eine ökonomisch-geographische Untersuchung über die Gesetzmässigkeit der Verbreitung und Entwicklung der Siedlungen mit städtischen Funktionen, Gustav Fischer, Germany, 1933.
- [28] P.W. Daniels, Central place theory. *International Encyclopedia of Geography: People, the Earth, Environment and Technology: People, the Earth, Environment and Technology*, 2016, pp. 1–3.
- [29] Park R.E. Burgess E.W. & MacKenzie R.D. (1967). *The City*. University of Chicago Press. pp. 4-60.
- [30] T. McPhearson, S.T. Pickett, N.B. Grimm, J. Niemelä, M. Alberti, T. Elmqvist, S. Qureshi, Advancing urban ecology toward a science of cities, *Bioscience* 66 (3) (2016) 198–212, <https://doi.org/10.1093/biosci/biw002>.
- [31] N. Brown, Robert Park and Ernest Burgess, *Urban Ecology Studies*, 1925. CSISS Classics, Center for Spatially Integrated Social Science, UC Santa Barbara, 2002. Retrieved from, <https://escholarship.org/uc/item/6f39q98d>.
- [32] Y.F. Tuan, Humanistic geography, *Ann. Assoc. Amer. Geogr.* 66 (2) (1976) 266–276, <https://doi.org/10.1111/j.1467-8306.1976.tb01089.x>.
- [33] D.C. Pocock (Ed.), *Humanistic Geography and Literature (RLE Social & Cultural Geography): Essays on the Experience of Place*, Routledge, 2014.
- [34] M.D. Jamhawi, R.K. Al-Shawabkeh, E.I. Alobaidat, Spatial modeling of transformation of public open spaces in Zarqa, Jordan, *Int. J. Sustain. Develop. Plann.* 15 (5) (2020) 685–703, <https://doi.org/10.18280/ijstdp.150511>.
- [35] P.J. Taylor, B. Derudder, Cities in Castells' theorising of social space, *Tijdschr. Econ. Soc. Geogr.* 113 (3) (2022) 250–256, <https://doi.org/10.1111/tesg.12516>.
- [36] M.E. Subtelny, The Timurid legacy: a reaffirmation and a reassessment, *Cahiers d'Asie Centrale* 3(4) (1997) 9–19.
- [37] O.N. Ruzimuratovna, The role of science and culture in the period of Temuriis, *Best J. Innov. Sci. Res. Develop.* 2 (2) (2023) 30–32.
- [38] M.S. Abdusattorovna, Historical roots of urban gardening of streets and squares, *Central Asian J. Arts Des.* 4 (2) (2023) 19–22, <https://doi.org/10.17605/OSF.IO/V9QDW>.
- [39] L. Golombek, The Gardens of Timur: new perspectives, *Muqarnas* 12 (1995) 137–147.

- [40] K. Ganiev, History of Samarkand gardens built by Amir Temur, *Eur. Scholar J.* 2 (5) (2021) 98. <https://www.scholarzest.com/>.
- [41] S. Sadikova, M. Amindjanova, GIS contribution to the collection and processing of the data for an architectural and graphic reconstruction of the Timurids' gardens in Samarkand region, in: *E3S Web of Conferences* 386, EDP Sciences, 2023, <https://doi.org/10.1051/e3sconf/202338606005>.
- [42] S.M. Xakberdiyeva, The history of Amir Temur's gardens and their role in urban ecology, *Int. J. Intellect. Cult. Herit.* 2 (1) (2022) 1–5. Retrieved from, <http://ihm.iscience.uz/index.php/ijich/article/view/44>.
- [43] S. Haeri, M.R. Masnavi, Analyzing and developing strategies for the ecological restoration of urban rivers in the framework of ecological urbanism, *MANZAR Sci. J. Landsc.* 15 (62) (2023) 54–71, <https://doi.org/10.22034/MANZAR.2023.356492.2204>.
- [44] S. Hagan, *Ecological Urbanism: The Nature of the City*, 1st ed., Routledge, 2014, pp. 22–43, <https://doi.org/10.4324/9781315761480>.
- [45] A.W. Spirn, *Ecological urbanism: a framework for the design of resilient cities* (2014). *The Ecological Design and Planning Reader*, 2014, pp. 557–571.
- [46] World Bank, *The State of Forests and Forest Landscapes in Uzbekistan*, 2022 at, <http://www.worldbank.org/>.
- [47] C. Albert, B. Schröter, D. Haase, M. Brüllinger, J. Henze, S. Herrmann, B. Matzdorf, Addressing societal challenges through nature-based solutions: how can landscape planning and governance research contribute? *Landsc. Urban Plan.* 182 (2019) 12–21, <https://doi.org/10.1016/j.landurbplan.2018.10.003>.
- [48] B. Sowińska-Świerkosz, J. García, What are Nature-based solutions (NBS)? Setting core ideas for concept clarification, *Nat.-Based Sol.* 2 (2022), 100009, <https://doi.org/10.1016/j.nbsj.2022.100009>.
- [49] A.J. Lynch, Creating effective urban greenways and stepping-stones: four critical gaps in habitat connectivity planning research, *J. Plan. Lit.* 34 (2) (2019) 131–155, <https://doi.org/10.1177/0885412218798334>.
- [50] H.E. Hoyle, C.G. Sant'Anna, Rethinking “future nature” through a transatlantic research collaboration: climate-adapted urban green infrastructure for human wellbeing and biodiversity, *Landsc. Res.* 48 (4) (2023) 460–476, <https://doi.org/10.1080/01426397.2020.1829573>.
- [51] E.K. Nassary, B.H. Msomba, W.E. Masele, P.M. Ndaki, C.A. Kahangwa, Exploring urban green packages as part of Nature-based Solutions for climate change adaptation measures in rapidly growing cities of the Global South, *J. Environ. Manage.* 310 (2022), 114786, <https://doi.org/10.1016/j.jenvman.2022.114786>.
- [52] Z. Juraev, Y.-J. Ahn, Essay: humanist Perspective of Space and Place, *Formosa J. Multidiscip. Res.* 2 (6) (2023) 1131–1136, <https://doi.org/10.55927/fjmr.v2i6.4732>.
- [53] E.E. Noe, O. Stolte, Dwelling in the city: a qualitative exploration of the human-nature relationship in three types of urban greenspace, *Landsc. Urban Plan.* 230 (2023), 104633, <https://doi.org/10.1016/j.landurbplan.2022.104633>.
- [54] Ibn, A. Arabshah, *Tamerlane: The Life of the Great Amir*, Hardcover Book. Page 83; V. M., 1937, *Tamerlane or Timur, The Great Amir*. Translated by J. H. Sanders, I.C. S. (ret.), from the Arabic Life by Ahmad Ibn Arabshah. pp. 341, London: Luzac and Co., 1936. 12s. 6d, *Bull. Sch. Orient. Afr. Stud.* 9 (1) (2017) 237–238, <https://doi.org/10.1017/S0041977X00070993>.

Prof. Dr. Young-Jin Ahn is a professor in the Department of Geography at Chonnam National University, Social Sciences College. His areas of expertise include economic geography, social geography, geography theory, regional development theory, and European regional studies. Professor Ahn can be reached at +8262-530-2686 or by email at yjahn@chonnam.ac.kr.

Mr. Zuhriddin Juraev is a Ph.D. student in the Department of Geography at Chonnam National University in Gwangju, South Korea. His research interests include economic geography, environmentalism, urban geography, and regional studies. Mr. Juraev can be contacted at 198928@jnu.ac.kr, and his ORCID is <https://orcid.org/0000-0002-6804-7273>.