

Chapter 8

Green Infrastructure for Sustainable Urban Development: The Case of Tehran

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Introduction

Urbanization stands as one of the defining trends of the 21st century, reshaping landscapes, economies, and societal structures globally. With more than half of the world's population now residing in urban areas, cities have become the epicenters of economic activity, cultural exchange, and technological innovation. However, this rapid urban growth has also brought forth a host of challenges, including increased energy consumption, exacerbated air and water pollution, traffic congestion, and the degradation of natural ecosystems. In response to these challenges, sustainable urban development has emerged as a critical paradigm to ensure that cities can grow and thrive while minimizing their environmental footprint and enhancing the quality of life for their residents.

At its core, sustainable urban development seeks to harmonize the economic, social, and environmental dimensions of urban life. It aims to meet the needs of present generations without compromising the ability of future generations to meet their own needs. This holistic approach goes beyond traditional urban planning by integrating principles of environmental sustainability, social equity, and economic resilience. By addressing issues such as climate change mitigation, biodiversity conservation, resource efficiency, and social inclusion, sustainable urban development aims to create cities that are not only environmentally sustainable but also economically prosperous and socially equitable.

Green infrastructure plays a pivotal role in achieving these goals by leveraging natural systems and processes to enhance urban resilience and sustainability. Green infrastructure encompasses a wide range of natural and semi-natural elements, including parks, gardens, street trees, natural water bodies, urban forests, green roofs, permeable pavements, and rain gardens. Parks and gardens provide essential recreational spaces, promote physical and mental well-being, and serve as habitats for urban wildlife. Incorporating vegetation into buildings through green roofs and walls helps reduce energy consumption, improve air quality, and mitigate urban heat islands while enhancing the aesthetic appeal of urban areas. Street trees improve air quality, provide shade, and enhance the overall urban landscape, contributing to reduced stormwater runoff. Natural water bodies, such as rivers, lakes, and wetlands, are crucial for biodiversity, water management, and recreational opportunities, adding to the aesthetic and cultural value of cities.

The benefits of green structure networks are manifold. They enhance urban biodiversity by providing habitats for various species and creating ecological corridors that facilitate the movement of wildlife, thus promoting genetic diversity and resilience against environmental changes. Vegetation in urban areas absorbs carbon dioxide, contributing to climate mitigation, while green spaces reduce the urban heat island effect, making cities more comfortable during hot weather. Access to green spaces is linked to better physical and mental health, offering spaces for exercise, relaxation, and social interaction, which are essential for overall well-being. Well-designed green spaces can also increase property values, attract businesses, and boost tourism, creating job opportunities in landscaping, maintenance, and environmental education.

Examples from around the world highlight the successful integration of green structure networks into urban planning. Copenhagen, Denmark, is renowned for its extensive network of green spaces, including parks, green roofs, and urban wetlands, integrated into its climate adaptation strategy to manage stormwater and reduce flooding risks (Danish Ministry of the Environment, 2014; Madsen et al., 2018). In New York City, the High Line, an elevated linear park built on a disused railway track, has transformed a neglected area into a vibrant public space, attracting millions of visitors annually and boosting local businesses (David, 2011; New York City Department of

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Parks & Recreation, 2020). Singapore, known as the "Garden City," has implemented an ambitious green infrastructure plan that includes vertical gardens, green roofs, and an extensive network of parks and nature reserves, making it a model for sustainable urban development (Tan & Jim, 2013; Singapore National Parks Board, 2015).

This section of the book, focuses specifically on the role of green infrastructure in promoting sustainable urban development in the case of Tehran, Iran's bustling capital city known for its rich cultural heritage and historical significance. Tehran faces unique challenges due to its rapid urbanization, geographical location, and socio-political context. The integration of green infrastructure in Tehran presents an opportunity to address these challenges while preserving and celebrating the city's cultural heritage.

The case of Tehran underscores the importance of innovative approaches that integrate green infrastructure with cultural heritage preservation. By strategically incorporating green spaces and sustainable design practices into urban planning initiatives, Tehran can enhance its resilience to environmental stresses, improve the quality of life for its residents, and safeguard its cultural identity for future generations. Case studies and practical examples from Tehran will illustrate how green infrastructure can be effectively implemented to create more livable, sustainable, and inclusive urban environments.

Through theoretical insights, empirical research, and practical case studies, this section aims to provide a comprehensive understanding of the synergies between green infrastructure, cultural heritage preservation, and sustainable urban development. By exploring these intersections, we can uncover actionable strategies and transformative solutions that can inspire and inform urban planners, policymakers, researchers, and practitioners worldwide. Ultimately, by embracing sustainable practices and integrating green infrastructure into urban planning and design, cities like Tehran can pave the way towards a more resilient, equitable, and sustainable urban future.

Defining Sustainable development

As we entered the modern era, architectural design underwent a transformative shift, profoundly shaping the identity and fabric of urban landscapes. Architects, directly and indirectly, wield considerable influence, accounting for 75% of climate change impact (Rogers, 2007), as over 50% of the Earth's resources are now allocated to the construction domain (Edward, 2009). Consequently, the construction sector significantly contributes to environmental challenges. The early 21st century experienced unsustainable development marked by explosive population growth, increased consumption, and an imbalanced distribution of resources. These factors led to far-reaching consequences such as climate change, ozone layer depletion, species extinction, and the disruption of natural habitats (Mahlabani, 2010, p. 92).

Responding to these environmental crises, the 1970s marked the beginning of a global awakening, leading to the sustainable development movement. This movement gained traction with the establishment of the World Conservation Strategy (WCS) Commission by the International Union for Conservation of Nature in 1980. In 1986, the World Commission on Environment and Development (WCED) introduced the term "sustainable development," defining it as meeting present needs without compromising future generations' ability to meet their own (Hopwood, Mary & Geoff, 2005: 38). This laid the groundwork for sustainable development to encompass various aspects of human life in harmony with the environment.

Sustainable development is now a comprehensive paradigm with broad and diverse meanings that various scholars have explored, encompassing different facets of human life and interactions with the environment. The Brundtland Commission's 1987 report, "Our Common Future," provided one of the most well-known definitions: "development that meets the needs of the present without compromising the ability of future generations to meet their own needs" (Azarbayjani & Mofidi, 2003; Azizi, 2001). However, the narrative of sustainable development extends beyond this definition. Figures like Paul Hyatt and Brian Edwards introduced a nuanced definition, attributing a significant portion of sustainable design to energy conservation, creating healthy, durable, economically viable spaces, and being responsive to local needs (Edwards & Paul, 2001: 7). Richard Rogers echoed these views, defining sustainable design as addressing future needs without depleting natural resources, emphasizing resource efficiency, minimal energy consumption, flexibility, and longevity (Rogers, 2007).

Moreover, sustainable development focuses on preserving environmental resources and ecosystems through tools and technology, aiming to enhance the quality of life for current and future generations (Shemirani & Mozaffarzadeh, 2014: 61). Since the United Nations Conference on Environment and Development in Rio in 1992, the term "development" has become crucial in scientific discussions (Adams, 2001: 1-2). Today, the concept of sustainable development arose from a growing awareness of global interconnections, environmental issues, social and economic concerns, poverty, inequality, and the desire for a healthy future for humanity. It interconnects environmental, social, and economic issues (Hopwood, Mary, & Geoff, 2005: 39). Kim and Rigdon (1998) outlined three fundamental principles of sustainability:

- **Resource efficiency:** Achieved through reduced consumption, reuse, and recycling of natural resources employed in construction.
- **Life cycle design:** Involving a method to analyze the construction process and its environmental impacts.

- **Human-centric design:** Focusing on the interaction between humans and the natural world.

Ultimately, the concept of sustainable development signifies a significant shift in understanding the relationship between humans, their environment, and society. It challenges the past two centuries' perspective that separated environmental, social, and economic issues. In the last two centuries, the environment was perceived as an external subject to humans, and the relationship between humans and the environment was seen as human dominance over nature, with the predominant belief that human knowledge and technology could overcome all environmental and natural obstacles (Mahlabani, 2010: 92). However, today's modern world faces a highly complex crisis. Our ecological system is rapidly deteriorating, our natural environment falls victim to pollution and unchecked exploitation (Norberg, 2003: 9), and humanity stands at a point where the impact of this dominance over nature poses fundamental challenges to sustaining life on this planet. Therefore, sustainable development is a hopeful course of action towards addressing these challenges and paving the way for the future of humanity.

In exploring innovative approaches to sustainable urban development, particularly within the context of Tehran, it's crucial to integrate green infrastructure with cultural heritage preservation. This integration involves more than just conserving historical sites; it means embedding cultural values and traditions into modern urban planning to create cities that are not only sustainable but also culturally rich and vibrant. The theoretical foundations of integrating cultural heritage with sustainable urban development emphasize the importance of community involvement and participatory planning. Engaging local communities ensures that development projects respect cultural contexts and foster a sense of ownership and pride. This approach creates inclusive public spaces that celebrate cultural diversity and heritage, enhancing social cohesion and community well-being.

Practical strategies for sustainable urban development in Tehran include creating and enhancing green infrastructure, such as parks, green corridors, and urban gardens, which integrate cultural and historical elements. This approach not only preserves cultural heritage but also revitalizes urban environments by making them more dynamic and inclusive. Designing public spaces with themes that reflect local traditions and cultural values fosters a sense of community and belonging.

By focusing on green infrastructure, cities can achieve sustainable development that honors the past while embracing the future. Utilizing landscape architecture principles, we can design urban spaces that are economically robust, socially inclusive, and environmentally resilient. The journey toward sustainable development is ongoing, and through innovative approaches to green infrastructure, we can build a future that respects both our environmental limits and our cultural heritage.

Sustainable Development: Sustainable urban development and landscape

Sustainable urban development is a complex concept that has garnered considerable attention from researchers seeking to define its parameters and understand its implications, particularly in relation to landscape integration. However, similar to the diversity in the definition of sustainable development discussed earlier, sustainable urban development also encompasses a variety of meanings. In a general sense, the theoretical foundations of sustainable urban development are based on the protection of natural resources, reduction of waste and pollution, increased recycling, energy efficiency, and the avoidance of urban concentration, along with the establishment of a balanced social structure and the creation of urban green areas (Ziari, 2000). These principles underscore a holistic approach to urban planning that seeks to harmonize city growth with environmental sustainability.

Sustainable urban development refers to the idea that cities should be designed and implemented in a way that minimizes harmful impact and intrusion into nature, essentially becoming a part of the surrounding environment. The concept of landscape emerges as pivot within sustainable urban development, encapsulating the intricate relationship between human activities and the natural environment. Early proponents of sustainable architecture, such as Jan Gehl, William Morris, and Richard Littabi, emphasized reconnecting urban dwellers with nature, advocating for designs that blend seamlessly with natural surroundings (Mansouri and Habibi, 2010). Today, the term "landscape" stands out as the most suitable term to capture this concept within the urban context. Landscape is defined as a comprehensive and practical concept in the organization of the environment, representing the multifaceted interaction between human and nature. Given that landscape is one of the key components capable of establishing a balanced and sustainable relationship between humans and the environment, it plays a crucial role in shaping cultural, ecological, social, and environmental foundations. Additionally, it can serve as a vital source for the exploitation and development of economic activities (Mansouri and Habibi, 2010).

From Barton's perspective, landscape integrates ecology, water management, and energy considerations into urban planning, highlighting its role in mitigating environmental impacts and enhancing urban resilience (Barton, 2000:10). Similarly, Antrop views landscape as a composite and integrated concept that refers to both the physical material reality resulting from continuous dynamic interaction between nature and human activities and the non-material values and symbols that landscape signifies. Antrop sees landscape as an all-encompassing concept that involves the combination of natural and human aspects in a stable state, preserving the inherited cultural and natural values in the interventions of urban development (Antrop, 2006: 188 & 190).

According to OECD guidelines, sustainable urban plans aim to minimize adverse effects on both constructed and natural environments, promoting comprehensive regional development (Abidin SA, 2008). In urban

landscapes, balancing natural elements with built environments is crucial for improving urban aesthetics, biodiversity, and overall quality of life (Kaplan, 1995). This approach emphasizes integrating green spaces, public parks, and recreational areas into urban designs to foster a closer connection between city dwellers and the natural world, creating attractive and sustainable urban environments (Chiesura, 2004).

The strategic inclusion of green infrastructure in megacities like Tehran holds significant promise for addressing environmental, social, and economic challenges. It can serve as a vital source for the exploitation and development of economic activities (Ziari, 2000: 18). Urban parks, often referred to as the "lungs" of the city, play multifaceted roles in enhancing mental health, promoting social cohesion, and providing recreational spaces essential for community well-being (Balram & Dragičević, 2005:149). These green spaces not only mitigate urban heat island effects but also contribute to air purification and stormwater management, crucial in densely populated urban settings.

Tehran, with its unique cultural heritage and geographical context, faces specific challenges in integrating green infrastructure amidst rapid urban expansion. Limited green spaces, coupled with escalating environmental issues such as air pollution and heat stress, underscore the urgency for sustainable urban planning interventions (Ziari, 2000). Nevertheless, the city's rich history of Persian gardens (Bagh) presents opportunities to reclaim and revitalize urban green spaces, preserving cultural identity while promoting environmental sustainability.

Case studies within Tehran illustrate pioneering efforts in green infrastructure development, exemplified by projects like Taleghani Park's transformation into a sustainable urban oasis. These initiatives underscore Tehran's commitment to enhancing urban greenery and public spaces, enhancing quality of life for its residents (Ziari, 2000). Moreover, endeavors like Pardisan Environmental Park showcase Tehran's strides in biodiversity conservation and environmental education, fostering public awareness and engagement.

Despite progress, challenges persist in implementing green infrastructure in Tehran, including financial constraints, competing land-use priorities, and institutional barriers. Overcoming these hurdles demands collaborative efforts among governmental bodies, private sectors, and community stakeholders. Policy interventions, such as incentives for green building practices and supportive regulations for green infrastructure projects, are essential to incentivize sustainable development practices and foster a culture of environmental stewardship.

Looking ahead, Tehran can leverage its cultural heritage and traditional knowledge to advance its green infrastructure agenda. By revitalizing historic gardens and embracing innovative green technologies, the city can bolster resilience against climate change, improve air quality, and promote sustainable urban lifestyles. Public engagement and education initiatives will be crucial in garnering community support and fostering a sense of ownership towards green infrastructure initiatives. In summary, green infrastructure represents a cornerstone of sustainable urban development in Tehran, offering pathways towards environmental resilience, cultural preservation, and social equity. By embracing innovative approaches and building upon its cultural heritage, Tehran can serve as a model for sustainable urban development in the Middle East and beyond. Through collaborative efforts and forward-thinking policies, cities can create inclusive, resilient, and livable urban environments that enhance well-being for current and future generations.

Urban Green Spaces: Towards Sustainability

In today's world, the significant impact of urban green spaces in citizen's life and its physical, natural, and social impacts on the urban system are undeniable. It is almost inconceivable to construct cities without green spaces. Hence, the existence of urban green spaces and their proper distribution per capita is one of the fundamental aspects in urban planning and promoting sustainable urban development. The term "urban green space" has been in use for less than half a century in global urban literature and encompasses various meanings and concepts. Urban green space refers to a type of urban land use with plant coverage, either human-made or natural, that possesses social and ecological benefits (Salahi Saadatloo, 1992: 52).

These green spaces manifest in various forms throughout cities. Traditional city parks and gardens often come to mind first, but urban green spaces extend beyond these iconic sites to include green corridors along streets, green rooftops atop public and private buildings, and other innovative green structures (Wentworth, 2017). Physically, these green structures comprise a network of interconnected elements such as green spaces like parks, water basins (zones), green pathways and valleys, ecological corridors, and water channels (corridors), designed either naturally or through deliberate urban planning efforts (Aminzadeh & Khansefid, 2009). Urban green infrastructure often incorporates corridor-patch-zone structures to enhance ecological connectivity and functionality within cities (Benedict & McMahon, 2002). Corridors act as linear pathways that connect patches of green spaces, facilitating movement for both wildlife and humans (Forman, 1995). These green corridors play a crucial role in maintaining biodiversity, promoting species migration, and mitigating urban heat island effects (Bolund & Hunhammar, 1999). In fact, green corridors serve as the heart of the system and include landscape connections, green corridors, and ecological belts (Herandi Zadeh, Ghasemi, & Karimi, 2019).

Green patches within this framework serve as nodes of biodiversity, providing habitats, recreational spaces, and aesthetic benefits (Ahern, 1995). In fact, green patches serve as vital connectors, varying in size and

shape to link green corridors and integrate seamlessly with surrounding urban areas, create origins and destinations for people moving in these corridors. These patches encompass protected green spaces, local parks, multifunctional recreational areas, and sites of historical and cultural significance, all contributing to the city's ecological and social vitality (Aminzadeh & Khansefid, 2009).

Meanwhile, green zones encompass larger areas that function as focal points for biodiversity conservation, climate regulation, and community recreation (Jim & Chen, 2006). Green zones, with larger sizes compared to green patches, function as points of origin and destination and, similar to green patches, create corridors as the third part of this network. Integrating these components effectively requires strategic planning and management to optimize urban green infrastructure's ecological and social benefits (Colding & Folke, 2009).

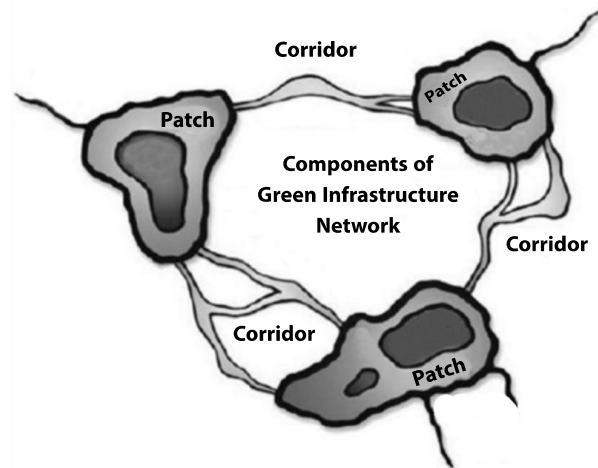


Figure 1. Components of Green Structure and their Interrelationships (Norouzi & Soozanchi, 2022: 225).

Figure 1 illustrates the complex interrelationships within the green structure, highlighting how these components interact to create cohesive urban ecosystems (Norouzi & Soozanchi, 2022: 225). Researchers have explored various urban planning theories and concepts that underscore the importance of integrating nature into urban environments. Concepts like the "broad suburban city" by Wright, the "garden city" by Howard, and the idea of "vertical buildings within a green framework" by Le Corbusier reflect diverse approaches to incorporating green spaces into urban design (Khansefid, 2008). Additionally, ideas such as urban open space networks (Turner, 2006; Cranz & Boland, 2005), park systems (Jongman & Pungetti, 2004; Harnik, 2006; Maruani & Irit, 2007), and greenway networks (Turner, 2006; Ahern, 1995 & 2002; Fabos, 2004; Little, 1999; McHarg, 1969) have been developed to enhance ecological interactions, sustainability, and environmental friendliness in the urban environment.

The Research and Planning Center of Tehran, in a study titled "Green Space Distribution Systems," identified six patterns for the layout and distribution of green spaces in Tehran:

- Dispersed green spaces system
- Green ring system
- Radial system
- Combined ring and radial system
- Curved linear system
- Linear system (Research and Planning Center of Tehran, 1994).

Furthermore, studies by Mohammadi and Almaspoor (2002) categorized green space location patterns into models such as minimum distance, maximum density, minimum distance power-based, minimum distance constraint-based, maximum coverage, and maximum coverage constraint-based, illustrating different urban planning approaches to green space distribution.

Kevin Lynch's theories on green space arrangement further enrich our understanding, proposing contrasting views on the spatial organization of urban greenery. While one theory advocates for scattered small open spaces to maximize accessibility (similar to the views of Mohammadi and Almaspoor), another promotes concentrated and extensive green areas that shape the urban fabric differently (Lynch, 2002). The difference between these two theories largely stems from different perceptions of the functioning of open spaces.

The "Connectivity" theory within urban green space networks emphasizes the importance of linking green patches, corridors, and zones to enhance spatial coherence, support mixed land-use development, and improve environmental sustainability (Stirling, 2011: 7-9). According to this theory, creating effective connections between green areas reduces fragmentation, supports biodiversity, and boosts the resilience of urban ecosystems (Xiu et al., 2016, Stirling, 2011; Taylor et al., 1993; Baguette et al., 2013; Lechner et al., 2015). Moreover, the network structure in urban landscapes (Connectivity theory) creates stable habitats for other living organisms, such as plants and animals. By reducing obstacles for the movement of various species between green patches, ecological networks

with better performance are established (Taylor et al., 1993; Baguette et al., 2013; Lechner et al., 2015). Creating connections between urban green spaces and building a green network contributes to the stability and spatial coherence, improving landscape management, enhancing climatic conditions, improving urban life quality, and establishing active natural ecosystems (Khansefid, 2008; Norouzi & Soozanchi, 2022). These connections not only facilitate the movement of wildlife and plants but also contribute to sustainable urban development by mitigating urban heat island effects and enhancing air quality (Xiu et al., 2016; Khansefid, 2008). Furthermore, green networks provide recreational spaces, improve urban aesthetics, and foster community health and happiness (Norouzi & Soozanchi, 2022). In the Connectivity theory, increased connections mean shorter distances, reduced fragmentation, and an increase in the ecological effectiveness of green spaces (Stirling, 2011: 7-9).

In summary, the Connectivity theory underscores how strategically integrating urban green spaces can enhance ecological, social, and environmental dimensions of urban life. By promoting connectivity, cities can bolster their resilience to urban challenges while fostering sustainable development. This holistic approach not only improves urban aesthetics but also supports biodiversity, enhances public health, and strengthens community cohesion. As cities like Tehran continue to evolve, the effective implementation and expansion of urban green spaces will be pivotal in shaping resilient, sustainable, and livable urban environments for current and future generations.

Green Spaces in Tehran

As mentioned earlier, considering the role of urban green spaces in achieving urban sustainability, preserving the coherence of the city's natural environment through urban ecological networks is essential for enhancing environmental quality and promoting the resilience of cities (Cook & Vanlier, 1994). Therefore, the proper distribution of green spaces in the city, taking into account their diverse ecological and social functions, holds significant importance in the development of a sustainable urban environment. Urban green spaces are pivotal to the fabric of modern cities, influencing the quality of life, environmental health, and social cohesion of urban dwellers. In today's rapidly urbanizing world, the significance of these green havens cannot be overstated. They serve as critical components of sustainable urban development, offering a range of ecological, social, and economic benefits. This comprehensive exploration delves into the specific case of Tehran, Iran's sprawling capital, analyzing its green space distribution, challenges, and proposing strategies to enhance urban sustainability through integrated green spaces.

Tehran's Urban Green Space Distribution

Tehran, with its vast expanse spanning approximately 730 square kilometers, encompasses 2,323 gardens covering over 60,175,423 square meters. It is geographically bounded by the Alborz Mountain range to the north, Lavasanat to the east, Karaj to the west, and Varamin to the south. Administratively, Tehran is divided into 22 regions, 119 districts, and 362 neighborhoods, each contributing to the city's diverse urban landscape. Despite its vast expanse, the distribution of green spaces within the city varies dramatically, reflecting broader socio-economic and developmental challenges (Statistical Yearbook of Tehran, 1400).

A critical examination of Tehran's urban green spaces reveals significant disparities in their distribution across the city's regions (Table 1). While some districts boast abundant green infrastructure, others struggle with limited provisions, impacting residents' quality of life and environmental sustainability. The Disparities are as follows:

- **Disparities and Environmental Implications**

District 1 and District 4 emerge as leaders in green space provision, boasting numerous parks and extensive green belt areas. **District 1** emerges as a leader with 208 parks covering 7,758,883 square meters and expansive green belt areas totaling 32,945,020 square meters. This district sets a benchmark for urban green space provision, fostering biodiversity and offering crucial recreational spaces for its residents. **District 4** stands out with an impressive 260 parks covering 14,235,231 square meters, alongside extensive green belt areas spanning 82,197,043 square meters. Such substantial green infrastructure underscores the district's commitment to environmental conservation and sustainable urban planning. These districts set benchmarks for biodiversity conservation and recreational amenities, enhancing environmental quality and promoting public well-being.

In contrast, District 9, alongside Districts 3, 6, 7, and 8, faces significant deficits in parkland and green belt coverage. **District 9** represents one of the least provisioned areas, featuring only 26 parks covering 187,096 square meters. The absence of significant green belt areas further exacerbates the district's challenges in providing accessible and adequate green spaces for its residents. **Districts 3, 6, 7, and 8** also demonstrate varying degrees of green space provision, with a notable disparity in park numbers and green belt coverage. These districts, while contributing to Tehran's overall green landscape, face challenges in balancing urban development with environmental conservation. This imbalance poses environmental challenges such as increased urban heat island effect and reduced air quality, which can adversely affect public health (Bolund & Hunhammar, 1999).

Table 1. The Status of Green Spaces in Tehran by District (Statistical Yearbook of Tehran, 1400)

DISTRICTS	GREEN BELT AREA	PARKS	
		Area	NUMBER
District 1	32,945,020	7,758,883	208
District 2	5,126,320	3,313,223	211
District 3	-	1,683,289	100
District 4	82,197,043	14,235,231	260
District 5	49,988,774	3,041,328	211
District 6	-	781,916	66
District 7	-	379,044	71
District 8	-	383,296	91
District 9	-	187,096	26
District 10	-	252,436	54
District 11	-	611,559	29
District 12	-	620,713	60
District 13	61,960,958	531,601	63
District 14	29,846,000	988,366	96
District 15	11,202,956	5,167,179	139
District 16	-	1,784,189	56
District 17	-	512,732	69
District 18	1,073,171	2,437,472	101
District 19	40,569,076	3,448,290	73
District 20	74,853,624	2,181,823	189
District 21	2,487,760	1,407,528	59
District 22	56,557,813	8,468,229	91

- **Ecological Consequences**

The fragmentation of green spaces, particularly evident in **District 16**, impedes wildlife movement and compromises ecosystem resilience, poses challenges for biodiversity conservation and ecosystem resilience. This district, characterized by disjointed patches of greenery amidst urban development, illustrates the detrimental effects of habitat fragmentation on local wildlife and ecosystem health. Fragmentation disrupts natural habitats and impedes wildlife movement across the urban landscape. Species reliant on continuous green corridors for migration, feeding, and breeding face increased isolation and reduced access to essential resources. This isolation can lead to genetic isolation among populations, reducing genetic diversity and resilience to environmental changes.

The fragmentation of green spaces in District 16 poses a direct threat to biodiversity. Fragmented habitats are more susceptible to species loss and local extinctions, as smaller and isolated populations struggle to survive in urbanized environments. Native flora and fauna, essential for maintaining ecosystem balance and resilience, may decline in numbers or disappear entirely without adequate habitat connectivity.

Urban expansion and development exacerbate habitat loss and fragmentation. As urban areas expand, green spaces are often reduced to isolated patches surrounded by roads, buildings, and infrastructure. This encroachment further isolates wildlife populations and disrupts ecological processes such as seed dispersal and pollination, essential for maintaining healthy ecosystems. In summary, this fragmentation threatens biodiversity and exacerbates habitat loss, underscoring the need for contiguous green corridors to support urban wildlife and maintain ecological balance (Forman, 1995).

- **Disparities in social Satisfaction**

Understanding how residents perceive and utilize green spaces across Tehran's districts provides valuable insights into urban livability and community well-being. These green spaces serve not only as recreational hubs but also as essential contributors to environmental quality and social cohesion. The uneven distribution of green spaces across Tehran raises critical issues of equity and environmental justice. The disparities in green space distribution across Tehran's districts directly influence community satisfaction levels. Residents in well-served districts generally

report higher levels of satisfaction with their living environment, citing easy access to green areas and the positive impact on their overall well-being. In contrast, residents in districts with fewer green spaces may express frustration over limited recreational options, higher levels of urban heat, and poorer air quality, affecting their perception of urban livability.

Addressing these disparities requires a comprehensive urban planning approach that prioritizes equitable access to green spaces for all residents. Implement policies aimed at ensuring fair and equitable distribution of green spaces across all districts, prioritizing underserved communities and areas with high population density (Jim & Chen, 2006). Strategies such as adaptive reuse of vacant lots, rooftop gardens, and vertical greenery can optimize limited urban spaces while enhancing environmental sustainability. Moreover, community engagement and participatory planning processes are crucial in ensuring that green space initiatives align with local needs and preferences. Empowering communities to advocate for green infrastructure investment can foster a sense of ownership and stewardship, promoting long-term sustainability.

Therefore, while Tehran's efforts to expand and manage urban green spaces are commendable, addressing the existing disparities and enhancing equitable access across all districts remain imperative. By prioritizing green infrastructure as a cornerstone of urban development, Tehran can mitigate environmental challenges, improve public health outcomes, and cultivate a resilient and sustainable city for future generations.

Challenges and Opportunities of Urban Green spaces in Tehran

The quest for sustainable urban development in Tehran is fraught with both challenges and opportunities. As the city continues to expand and modernize, the distribution and management of its green spaces become increasingly critical. These green spaces, ranging from parks and gardens to green corridors and rooftops, play a pivotal role in enhancing the quality of life, promoting biodiversity, and mitigating environmental stresses. However, the fragmented nature of Tehran's green spaces presents significant hurdles. Isolated green patches and corridors, especially those situated in peripheral areas, face threats from rapid urbanization and development pressures. In contrast, the densely built-up city center suffers from a scarcity of natural green areas, exacerbating urban heat island effects and reducing biodiversity.

Moreover, the unequal distribution of green spaces across different districts creates disparities in access and environmental quality. Some areas enjoy abundant green infrastructure, while others are starkly deficient, leading to inequities in public health and well-being. Addressing these challenges requires a multifaceted approach that integrates strategic urban planning, innovative green space utilization, and active community engagement.

In this context, we will explore the specific challenges posed by the fragmented and imbalanced distribution of Tehran's green spaces. We will also highlight the opportunities for enhancing urban sustainability through more cohesive planning and equitable distribution of green infrastructure. By examining these aspects, we aim to provide a comprehensive understanding of how Tehran can navigate its path towards a more sustainable and resilient urban future.

- **Challenges:**

Fragmentation of Green Spaces:

The green spaces in Tehran are fragmented, particularly in the city center, leading to environmental stresses such as urban heat island effects and reduced biodiversity (Danilina & Majorzadehzahiri, 2021). The disconnection of green patches, corridors, and urban green zones, primarily located in peripheral areas, further exacerbates this fragmentation. A closer examination of the green space map of Tehran reveals the utilization of a linear distribution system in some city areas. Given that green spaces are crucial elements for urban sustainability and linearly shaped spaces possess more ecological elements compared to fragmented and isolated models, the adoption of a continuous structure has proven more successful in preserving and sustaining the natural state (Aminzadeh & Khansefid, 2009).

Encroachment and Degradation:

Isolated green patches and corridors in peripheral areas are susceptible to encroachment and degradation due to rapid urbanization and development pressures.

Environmental Stresses in the City Center:

The dense urban fabric in the city center has a scarcity of natural green areas, contributing to environmental stresses, urban heat island effects, and reduced biodiversity. Studies suggest that sustainability in the network is established, leading to a division of strengths and weaknesses among green patches throughout the city (Norouzi & Soozanchi, 1401: 226). Consequently, the absence of coordinated activities and uses and, consequently, the lack of connections between green patches in Tehran lead to the vulnerability of these urban green spaces and hinder ecological connectivity.

Imbalanced accessibility to Green Spaces:

The green space system in Tehran is designed in a scattered manner, leading to imbalanced distribution and inequities in access to green spaces across different city areas. As depicted in Figure 2, green patches, corridors,

and urban green zones in Tehran are largely disconnected from each other, primarily located in peripheral areas. Some smaller patches along river valleys are fertile due to rich soil and abundant water. However, with the intrusion of rivers into the city, from north to south, their size decreases. Natural patches are rare in the city center, and weak relationships exist between these natural patches due to urban development. Analyzing the urban landscape matrix of Tehran, green patches are dispersed to their maximum extent in the west and east. In the center, scattered green patches are surrounded by dense urban fabric. In the south, most areas have been transformed into agricultural land. Reading Tehran's urban fabric, protected lands and forests in the east gradually shift to highly dense central areas and then to open and artificial green patches in the west. The imbalance in utilizing urban green spaces across Tehran is evident. Consequently, it can be inferred that Tehran significantly deviates from the concept of a sustainable city in the environmental domain, resulting from the detachment of green patches and the lack of coherence with green corridors.



Figure 2. Current distribution of Tehran Green Space

Vulnerability to Development:

The detachment of green patches and lack of coherence with green corridors not only influences the per capita green space but also renders the cityscape vulnerable to development. Many urban development plans, instead of embracing ecological networks and utilizing them as natural potentials, tend to destroy or fragment them, leading to serious environmental impacts in urban areas. In the case of Tehran, this issue is prominently displayed, and one of the primary causes of environmental damages in the city can be attributed to the fragmentation of the urban green network. As a consequence, encroaching upon the sanctity of green patches becomes more accessible for urban developers.

Challenges in Management and Preservation:

Fragmented green spaces are easier to demolish and harder to manage, making preservation efforts more challenging. Moreover, this fragmentation triggers extensive migration of wildlife species requiring broader ecosystems, resulting in an ecological imbalance in the region.

Public Indifference:

In a general overview, the green space system in Tehran appears to be designed in a scattered manner to provide access to a larger population. However, due to the imbalanced distribution in different areas of the city, this access is not uniform for all citizens, leading to inequities in accessing urban green spaces. The lack of universally balanced access to green spaces leads to public indifference toward their preservation, further threatening their sustainability.

By addressing these challenges and leveraging the opportunities for improvement, Tehran can enhance its urban green spaces, contributing to a more sustainable, resilient, and livable city for all its residents.

Proposed Strategies for Integrating Green Spaces of Tehran

Addressing the complex challenges posed by Tehran's green space distribution requires a multifaceted approach that integrates urban planning, community engagement, environmental stewardship, policy development, biodiversity conservation, and learning from global best practices.

1. Green Corridor Development:

Creating and expanding green corridors that connect existing green areas is crucial. These corridors not only enhance biodiversity and ecological resilience but also promote sustainable urban mobility and improve the overall aesthetic of the city. They serve as pathways for wildlife movement and mitigate the environmental impacts of urban development.

2. Community Engagement:

Engaging local communities in the planning, maintenance, and conservation of green spaces is essential. By involving residents in decision-making processes, through initiatives like volunteer programs, educational campaigns, and participatory planning, we can foster a sense of ownership and stewardship among the people of Tehran. In addition, it empowers residents to contribute actively to green space preservation and sustainable urban development.

3. Environmental Impact Assessment:

Integrating rigorous environmental impact assessments into urban development projects ensures that decisions prioritize ecological conservation. By carefully evaluating the potential environmental consequences of new developments, Tehran can implement mitigation measures and sustainable land-use practices that protect natural habitats and enhance urban resilience.

4. Legislation and Policies:

Strengthening legislative frameworks and implementing policies that protect and promote green spaces are critical. This includes zoning regulations, green building standards, incentives for green infrastructure, and preservation ordinances that provide legal mechanisms to integrate green spaces into urban planning and mitigate the negative impacts of urbanization.

5. Biodiversity Conservation:

Enhancing biodiversity within urban green spaces through habitat restoration, native species planting, and ecological enhancements is vital. Creating habitats that support diverse wildlife populations not only improves urban biodiversity but also contributes to the overall health and resilience of urban ecosystems.

6. Case Studies and Best Practices:

Drawing insights from successful case studies and best practices worldwide provides valuable lessons for Tehran's sustainable development journey. By studying how other cities have effectively integrated green spaces into their urban fabric, Tehran can adopt practical strategies, innovative approaches, and management practices tailored to its unique context and challenges.

7. Public Awareness and Education:

Increasing public awareness about the importance of green spaces and biodiversity through educational programs, workshops, and outreach campaigns can foster a culture of environmental stewardship among Tehran's residents. This can encourage more active participation in green initiatives and promote responsible behavior towards urban green areas.

8. Green Infrastructure Investment:

Allocating resources for the development and maintenance of green infrastructure, such as parks, gardens, and green roofs, is crucial. This investment not only enhances the quality of life for residents but also contributes to climate resilience, reduces urban heat island effects, and improves air and water quality.

9. Partnerships and Collaboration:

Forming partnerships with academic institutions, NGOs, private sector organizations, and community groups can leverage expertise and resources to implement green space initiatives more effectively. Collaborative efforts can lead to innovative solutions and sustainable funding mechanisms for long-term green space management and conservation.

10. Monitoring and Evaluation:

Implementing robust monitoring and evaluation frameworks to assess the impact of green space initiatives is essential. Regular assessments can track biodiversity indicators, public usage patterns, and environmental benefits, helping to refine strategies and ensure continuous improvement in green space management practices.

11. Inclusive Design and Accessibility:

Ensuring that green spaces are designed inclusively and are accessible to all residents, including people with disabilities and different socioeconomic backgrounds, promotes social equity and enhances community cohesion. Designing spaces that cater to diverse needs encourages broader public engagement and enjoyment of green areas.

Discussion and Conclusion

Throughout this paper, we have explored the crucial role that urban green spaces play in promoting sustainability and preserving the natural fabric of cities through integrated networks. We've delved into the conceptualization of urban green spaces, clarifying their meanings and discussing various theories on their distribution and accessibility. Emphasizing urban ecology's role in enhancing environmental quality and sustainable development, we underscored the importance of appropriately distributing green spaces to serve both ecological and social functions.

Our research findings underscore the pivotal role of green spaces in urban sustainability and preserving Tehran's natural landscape. The analyses revealed that green space in Tehran has been regulated in a dispersed manner to ensure broader public access. However, its imbalanced distribution has led to inequalities in access, creating disparities among citizens. Our analysis of Tehran's green space map revealed a fragmented approach, posing challenges to urban sustainability and the city's natural integrity. Additionally, the analysis of Tehran's green space map exposed the use of a linear distribution system in some areas, posing challenges to urban sustainability and the preservation of the city's natural structure.

The case study of Tehran highlighted issues like disconnected green spaces and limited connectivity to green corridors, which neglects ecological networks and exacerbates environmental problems. Addressing these challenges in urban planning and development should be a priority. Consequently, the research findings for Tehran emphasize the importance of focusing on the issue that the distribution of green spaces in Tehran has taken a detached and fragmented form. This detachment and lack of coherence stand among the significant reasons for environmental damages in Tehran's urban areas. Indeed, fragmenting and destroying urban green spaces, instead of enhancing urban sustainability and ecological friendliness, results in the destruction of natural resources and adverse effects on the city's environment.

Moreover, our findings emphasize how imbalanced distribution and lack of a continuous network in urban green spaces contribute to the destruction of green patches and harm urban ecology. This issue, compounded by the destruction of green spaces in urban development projects, has severe environmental impacts and threatens regional ecological balance. It also induces the migration of wildlife species requiring larger ecosystems, posing a greater threat to ecological balance in the region. It's clear from the findings of this research that preserving and developing urban green spaces and creating cohesive ecological networks are essential for enhancing environmental quality and achieving sustainable cities.

Despite the benefits, implementing green infrastructure faces challenges. Urban land scarcity and costs make allocating space for green areas difficult, and maintaining them requires ongoing investment and community engagement (Benedict & McMahon, 2006; Kabisch & Haase, 2014). Future efforts should focus on integrating green infrastructure into urban planning from the outset, requiring collaboration between government agencies, urban planners, architects, and the community. Innovative solutions like vertical gardens and multi-functional green spaces can maximize benefits on limited urban land. Green infrastructure networks are crucial for sustainable urban development, offering ecological, social, and economic benefits that enhance urban life quality. By prioritizing green space integration, cities can become more resilient, healthier, and sustainable for future generations.

In conclusion, the preservation and development of green spaces, along with creating robust ecological networks, are imperative for enhancing environmental quality and sustainability in cities. These efforts not only promote ecological health but also contribute to social equity by ensuring all residents have access to green spaces. As cities evolve, prioritizing green infrastructure will be pivotal in achieving sustainable urban development and fostering livable urban environments for all.

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Conflict of Interests

The author declares no conflict of interest.

References

- Abidin SA, Sigurjonsson J, Liem A, Keitsch M. (2008). "On the role of form-giving in design. New Perspectives in Design Education." *Proceeding of the 10th International Conference on Engineering and Product Design Education*. Barcelona: Universitat Politecnica de Catalunya. 365-370. 10.13140/2.1.1922.4649

- Adams, W.M. (2001). *Green Development: Environment and Sustainability in the Third World*. 2nd Edition. London: Routledge. <https://doi.org/10.1111/0033-0124.51109>
- Ahern, J. (1995). "Greenways as a planning strategy." *Landscape and urban planning* 33 (1-3): 131-155. 10.1016/0169-2046(95)02039-V
- Ahern, J. (2002). *Greenways as strategic landscape planning: theory and application*. Dissertation, Wageningen, the Netherlands: Wageningen University.
- Aminzadeh, B., & Aryaman, P. (2004). "Design principles and tactics of post-industrial landscape" *Honar-ha-ye Ziba*, 20, 37-48.
- Aminzadeh, B., and Mahdi Kh. (2009). "A case study of urban ecological networks and a sustainable city: Tehran's metropolitan area." *Urban Ecosystems* 13: 23-36. 10.1007/s11252-009-0101-3
- Antrop, M. 2006. "Sustainable landscapes: contradiction, fiction or utopia?" *Landscape Urban Plan* 75 (3-4): 187-197. 10.1016/j.landurbplan.2005.02.014
- Azarbayjani, M., & Mofidi, S. M. (2003). "Concept of Sustainable Architecture." In Proceedings of the Third Conference on Fuel Consumption Optimization in Buildings. Tehran: National Fuel Consumption Optimization Organization, 348-356.
- Baguette, M., Simon B., Delphine L., Virginie M. S., and Camille T. (2013). "Individual dispersal, landscape connectivity and ecological networks." *Biological Reviews* 88(2): 88 (2): 310-326. 10.1111/brv.12000
- Balram, Shivanand, and Suzana Dragičević. (2005). "Attitudes toward urban green spaces: integrating questionnaire survey and collaborative GIS techniques to improve attitude measurements." *Landscape and Urban Planning* 71 (2-4): 147-162. 10.1016/j.landurbplan.2004.02.007
- Barton, H. (2000). *Sustainable Communities. The Potential for Eco-Neighborhoods*. London: Earthscan Publications Ltd.
- Benedict, M.A., & McMahon, E.T. (2002). Green infrastructure: Smart conservation for the 21st century. *Renewable Resources Journal*, 20(3), 12-17.
- Benedict, M. A., & McMahon, E. T. (2006). *Green infrastructure: Linking landscapes and communities*. Island Press.
- Bolund, P., & Hunhammar, S. (1999). Ecosystem services in urban areas. *Ecological Economics*, 29(2), 293-301.
- Bunn, A. G., Urban, D. L. and Keitt, T. H. (2000). "Landscape connectivity: a conservation application of graph theory." *Journal of environmental management* 59 (4): 265-278. 10.1006/jema.2000.0373
- Chiesura, A. (2004). "The role of urban parks for the sustainable city." *Landscape and Urban Planning* 68: 128-138. 10.1016/j.landurbplan.2003.08.003
- Colding, J., & Folke, C. (2009). The role of golf courses in biodiversity conservation and ecosystem management. *Ecological Applications*, 19(6), 1418-1427.
- Cook, E., and Vanlier, H.N. (1994.) *Landscape planning and ecological networks*. Amsterdam: Elsevier.
- Cranz, G., and Boland, M. (2005). "Defining the sustainable park: a fifth model for urban parks." *Landscape Journal* 23 (2): 102-120. 10.3368/lj.23.2.102
- Danilina, N. V., Majorzadehzahiri, A. (2021), Analysis situation of urban green space framework in Tehran, *Vestnik MGSU*, 16(8):975-985. <https://doi.org/10.3846/20297955.2016.1210047>
- Danish Ministry of the Environment. (2014). *Green Infrastructure in Denmark*. Copenhagen: Danish Ministry of the Environment.
- David, J. (2011). *The High Line: The Inside Story of New York City's Park in the Sky*. New York: Farrar, Straus and Giroux.
- Edwards, B., and Hyatt P. (2001). *Rough Guide to Sustainability*. London: RIBA Publications.
- Fabos, J. Gy. (1995). "Introduction and overview: the greenway movement, uses and potentials of green- ways." *Landscape and urban planning* 33 (1-3): 1-13. [https://doi.org/10.1016/0169-2046\(95\)02035-R](https://doi.org/10.1016/0169-2046(95)02035-R)
- Fabos, J. Gy. (2004). "Greenway planning in the United States: its origins and recent case studies." *Landscape and Urban Planning* 68: 321-342. 10.1016/j.landurbplan.2003.07.003
- Forman, R.T.T. (1995). *Land mosaics: The ecology of landscapes and regions*. Cambridge University Press.
- Groome, D. (1990). "Green corridors: a discussion of a planning concept." *Landscape and Urban Planning* 19 (4): 383-387. [https://doi.org/10.1016/0169-2046\(90\)90044-3](https://doi.org/10.1016/0169-2046(90)90044-3)
- Harandi zadeh, S., Ghasemi, E., & Karimi, Sh. (2019). "Designing an Integrated Pedestrian Network with a Green Structure Approach: Towards Addressing Climate Change Challenges (Case Study: Isfahan's Historical Fabric)." In Proceedings of the Ninth International Conference on Sustainable Development and Urban Construction. Isfahan: Applied Educational Center of the Cooperation Organization of Isfahan Municipalities.
- Harnik, P. (2006). *The excellent city park system*. San Francisco, CA, USA: The Trust for Public Land.
- Hopwood, Bill, Mellor Mary, and O'Brien Geoff. (2005). "Sustainable Development: Mapping Different Approaches." *Sustainable Development* 13 (1): 38-52. <https://doi.org/10.1002/sd.244>
- Jim, C.Y., & Chen, W.Y. (2006). Assessing the ecosystem service of air pollutant removal by urban trees in Guangzhou (China). *Journal of Environmental Management*, 79(3), 266-276.
- Jongman, R., and G. Pungetti. (2004). *Ecological networks and greenways concept, design, implementation*. UK: Cambridge University Press. 10.1017/CBO9780511606762

- Kabisch, N., & Haase, D. (2014). Green justice or just green? Provision of urban green spaces in Berlin, Germany. *Landscape and Urban Planning*, 122, 129-139.
- Khansefid, M. (2008). "Investigating the Distribution Patterns of Urban Green Spaces with the Approach of Urban Landscape Ecology and its Relationship with Urban Sustainability, Case Study: Tehran Metropolis" In *Proceedings of the Third National Conference on Green Spaces and Urban Landscape*. Kish: Shahrdariha, 147-156.
- Khansefid, M. (2008). "Infrastructure as Landscape: Integrating Human and Natural Realms in Urban Highways Planning and Design" *Manzar*, 36(8), 78-89.
- Kaplan, S. (1995). "The restorative benefits of nature: Toward an Integrative Framework" *Journal of Environmental Psychology*. 169-182 :15 [https://doi.org/10.1016/0272-4944\(95\)90001-2](https://doi.org/10.1016/0272-4944(95)90001-2)
- Kühn, M. (2003). "Greenbelt and Green Heart: separating and integrating landscapes in European city regions." *Landscape and urban planning* 64 (1-2): 19-27. 10.1016/S0169-2046(02)00198-6
- Lechner, A. M., Brown G., and Raymond, Ch. M. (2015). "Modeling the impact of future development and public conservation orientation on landscape connectivity for conservation planning." *Landscape Ecology* 30 (4): 699-713. 10.1007/s10980-015-0153-0
- Little, Ch. E. (1999). *Greenway for America*. Baltimore: Johns Hopkins University Press.
- Lynch, K. (2002). "A Theory of Good City Form." Tehran: University of Tehran Press.
- Madsen, H. M., Rosbjerg, D., & Hansen, E. (2018). Managing Urban Flood Risk in a Changing Climate: Challenges from Copenhagen's Cloudburst Management Plan. *Water Resources Research*, 54(2), 925-939.
- Mahlabani, Y. G. (2010). "Sustainable Architecture and its Critique in the field of Environmental" Scientific Association of Architecture and Urban Planning in Iran, 1, 91-100.
- Mansouri, S. A., & Habibi, A. (2010). "An Analysis of Factors Contributing to the Formation of Landscapes Ensuring Sustainable Environments A Case Study of the River Khoshk in Shiraz" *Bagh-e Nazar*, 15, 63-78.
- Maruani, T., and Irit, A. (2007). "Open space planning models: A review of approaches and methods." *Landscape and Urban Planning* 81: 1-13. 10.1016/j.landurbplan.2007.01.003
- McHarg, I. L. (1969). *Design with nature*. New York: Wiley.
- Merriam, G. (1984). "Connectivity: a fundamental ecological characteristic of landscape pattern. In *Methodology in landscape ecological research and planning: proceedings*", 1st seminar, *International Association of Landscape Ecology*. Roskilde, Denmark: Roskilde University Centre.
- Mohammadi, A. A., & Almaspoor, F. (2002). "Application of geographic information systems for network analysis, spatial distribution and location of pharmacies (Case study: District 6 of Tehran)." *Geographical Research*, 67, 50-62.
- New York City Department of Parks & Recreation. (2020). The High Line. Retrieved from nycgovparks.org.
- Noroozi, M., & Sozanchi, K. (2022). "Study of the Role of Urban Infrastructure in Urban Green Network Formation" *Armane Shahre*, 221-242. 10.22034/AAUD.2022.269053.2429
- Rogers, R. (2007). *Sustainability*. www.richardrogers.co.uk.
- Rudnick, D. A., Sadie J. R., Beier, P., Cushman, S. A., Dieffenbach, F., Epps, C. W., Gerber, L. R. et al. (2012). "The role of landscape connectivity in planning and implementing conservation and restoration priorities." *Ecology* 6: 1-20.
- Salahi S., Mir P. (1992). "Preservation and Development of Green Spaces and its Problems in big Cities due to Population Growth and Rural Migration to Urban Areas." In *Proceedings of the Seminar on Green Spaces*. Tehran: Parks and Green Spaces Organization, 52-66. <https://doi.org/10.1016/j.envc.2021.100283>
- Shamirani, S., Mofidi, M. & Maztorezadeh, H. (2014). "Explaining the Sustainable Urban Community Structural Criteria" *Bagh-e Nazar*, 11(29), 59-70. <http://dx.doi.org/10.22075/ijnaa.2023.31250.4594>
- Singapore National Parks Board. (2015). *Singapore: City in a Garden*. Retrieved from nparks.gov.sg.
- Statistical Yearbook of Tehran. (2021). Tehran: Tehran Municipality. Information Technology and Urban Statistics Center.
- Stirling Council. (2011). *Draft splintery guidance 02, Green infrastructure: Green network and open space*. Stirling: Stirling council local development plan.
- Tan, P. Y., & Jim, C. Y. (2013). *Greening Cities: Forms and Functions*. Singapore: Springer.
- Tavahen, A. (2004). "Editorial Notes." *Shahrdariha*, 17.
- Taylor, J., Cecelia P., and Gibbon, J. F. (1995). "From greenbelt to greenways: four Canadian case studies." *Landscape and urban planning* 33 (1-3): 47-64. [https://doi.org/10.1016/0169-2046\(94\)02013-6](https://doi.org/10.1016/0169-2046(94)02013-6)
- Taylor, P. D., Fahrig, L., Henein, K., and Merriam, G. (1993). "Connectivity is a vital element of landscape structure." *Oikos* 68 (3): 571-573. <https://doi.org/10.2307/3544927>
- Tehran Urban Research and Planning Center. (1994). "Green Space Distribution Systems." Tehran: Unpublished report of Tehran Urban Research and Planning Center.
- Turner, T. (2006). "Greenway planning in Britain: recent work and future plans." *Landscape and Urban Planning* 76 (1-4): 240– 251. <https://doi.org/10.1016/j.landurbplan.2004.09.035>

- Wentworth, J. (2017). *Urban Green Infrastructure and Ecosystem Services*. London, UK: POSTbrief from UK Parliamentary Office of Science and Technology. <https://doi.org/10.1016/j.landurbplan.2018.06.001>
- Xiu, N., Ignatieva, M., and van den Bosch, C. K. (2016). "The challenges of planning and designing urban green networks in Scandinavian and Chinese cities." *Journal of Architecture and Urbanism* 40 (3): 163-176. [10.3846/20297955.2016.1210047](https://doi.org/10.3846/20297955.2016.1210047)
- Ziyari, K. (2000). "Planning New Cities." Tehran: Samt Publications.