Green Infrastructure: Strategy of Climate-Resilient Urban Planning in Developing Countries

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This paper analyses green infrastructure implementation for climate-resilient urban planning focusing on cases from Iran, India, and Kazakhstan. The project aims to compare and analyze GI approaches, focusing on their contributions to mitigating climate change impacts. The analysis examines the benefits and challenges of GI, such as reducing the urban heat island effect, managing energy demands, and improving air quality. The findings showed that, despite cases of GI application with positive outcomes in the mentioned developing countries, GI is still poorly developed due to a lack of funding, governmental policies, and related research. Thus, it is recommended to promote research and implementation of green infrastructure in developing countries due to its multifunctionality, which provides social, economic, and environmental benefits

1. Introduction

Rapid urbanization and climate change create significant challenges for the sustainable development of urban areas, especially in developing countries, where the population is more vulnerable to climate-induced disruptions. To expand on that, urban areas, comprising only 3% by area, are home to more than half of the human population, making them centers not only for economic development but also ecological issues, especially because climate change-related disasters are projected to intensify both in quantity and amplitude in the coming years (Mitchell et al., 2015; Sharifi & Yamagata, 2022). In the context of such developments, the concept of climate-resilient urban planning is becoming more relevant than ever, and green infrastructure has emerged as a transformative approach to achieving it.

Green Infrastructure (GI) could be defined as an engineered network of natural habitats, specifically designed to provide a broad spectrum of ecosystem services (European Commission, n.d). Thus, GI offers a holistic approach to urgent issues by providing not only environmental but also economic and social benefits. To elaborate further, GI ensures climate resilience by improving stormwater management, mitigating the heat island effect, improving infrastructure energy demands, creating public recreational places, etc. For example, permeable concrete pavement is an example of green infrastructure because it mimics the natural hydrological cycle to recharge groundwater resources and minimize urban flooding (EPA, n.d). So, other examples of green infrastructure are rain gardens, green roofs, and living shorelines. Nevertheless, GI should be carefully designed to site-specific conditions and needs to maximize the potential benefits.

Recognizing the advantages of GI, many developed countries encourage its adaptation. Thus, the European Union developed the EU Green Infrastructure Strategy to increase the implementation of GI and battle the loss of biodiversity (European Commission, 2013). Some examples are urban forests in Barcelona and Manchester and mandatory green roofs in

Toronto (Lang & Taylor, 2023). However, green infrastructure is not as widespread in developing countries. Consequently, this paper aims to analyze case studies of GI application across developing countries in Asia to promote further research and governmental initiatives development in this field.

The world's most populated countries are located in Asia and this continent accounts for more than 50% of the global urban population with rapidly expanding urban areas, most of them still lack experience in urban planning and enforcing climate adaptation initiatives (Tyler & Moench, 2012). Hence, the development of climate-resilient urban practices is crucial to ensure the sustainable development of rapidly growing Asian cities. The countries selected for this paper represent different regions of Asia with varying economic, social, and climatic conditions: India represents South Asia, Iran - Middle East, and Kazakhstan - Central Asia. Presenting and comparing different cases of GI application in these states will demonstrate the potential of its adaptation for urban climate resilience in developing countries.

2. Conceptual Framework and Methodology

This study employs a mixed-method methodology by conducting a literature review to provide background information on GI, providing case analysis by examining specific projects in Kazakhstan, India, and Iran, and creating comparative analysis by evaluating similarities and differences of GI implementation in selected countries.

Two main characteristics of this study are worth noting: the definition of GI and the focus on climate resilience. There are many definitions for GI, which could complicate the selection of relevant case studies, but in the scope of this paper, the definition provided by the European Commission will be followed, focusing on the main aspect of GI as nature-based engineering solutions that aim to provide a wide range of benefits. Green infrastructure provides economic benefits by decreasing infrastructure costs, social benefits by increasing the liveability of urban spaces, and environmental benefits by improving air quality, rainwater management, etc (EPA, n.d). This paper will mainly focus on environmental benefits and their link to climate resilience.

3. Case-Studies

3.1 Kazakhstan

Kazakhstan, as the biggest landlocked country in the world, experiences challenges in urban development due to its geographical and climatic conditions since most of the land is covered by steppes, which are characterized by the absence of trees and high-temperature amplitudes (Sinor et al., 2025). The country experiences rapid urbanization rates, especially in Astana and Almaty. These conditions prompt the interest of Kazakhstan in GI as a climate-resilient urban planning approach.

3.1.1 Green Belt Initiative in Astana

Focusing on the specific case of GI, the Green Belt project in Astana started in 1997. This project aimed to plant 1000 square kilometers of forest to mitigate the harsh continental

climate of the country's capital, specifically reducing wind load and mitigating air and dust pollution. The vegetation is planted in the city and around its border as well, which can be seen in Figure 1. The project is still ongoing and will reach its full potential in around 50 years, but the decrease in average temperature by 0.3 degrees and basic wind speed is already evident (Yelemessov, 2018). Also, the project's moderating effect on surface temperature was confirmed by spatial temperature analysis over a 6-year period that showed a decrease in very cold clusters from 82.98% to 61.6% (Castillo, n.d).

What makes this initiative an example of GI? First of all, the forestation was preceded with extensive research to select optimal types of trees to ensure their livability by growing them in laboratory conditions and mitigating the risk of wildfires by planting trees in a specific fashion (Yelemessov, 2018). To further expand on the extent of R&D needed, the 104 species of trees and vegetation were tested with only 24 types recognized as suitable for further foresting, each tree is grown in laboratory conditions for up to 2-3 years to improve adaptation to the environment (Kyzekbay, 2021). Moreover, the Green Belt improves biodiversity by creating environments to house animal species, including foxes, hares, partridges, and even marals, which are endangered species, whose natural habitats are often destroyed due to deforestation (Baibusinov, 2017). Secondly, this initiative serves the definite purpose of improving urban microclimate, while providing a wide range of additional benefits like the creation of recreational places for residents by adding bicycle and horse-riding paths.

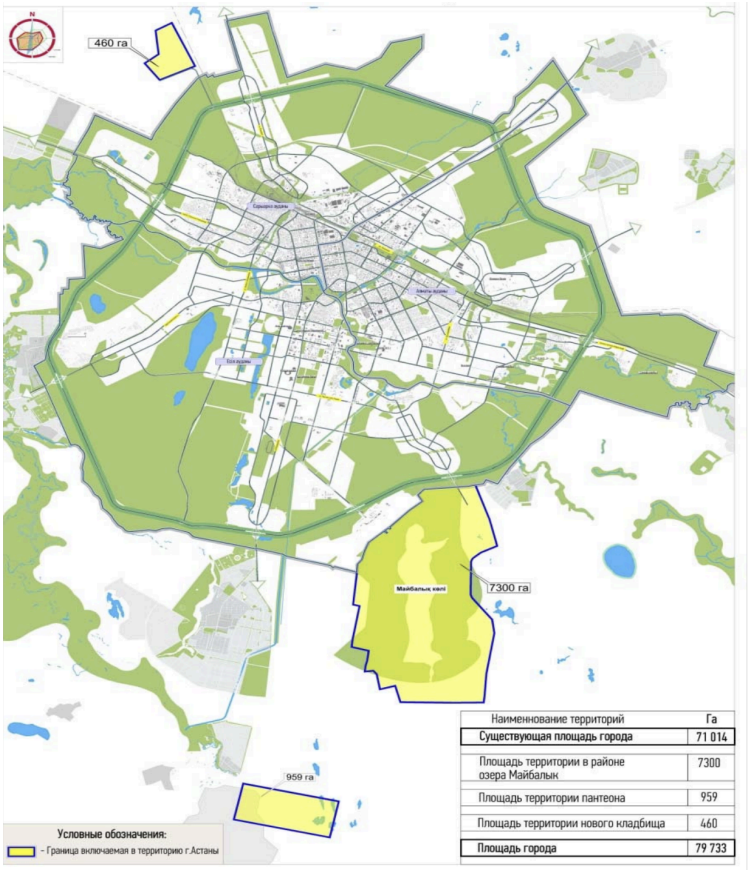

Figure 1: Green Belt in City's Master Plan (Ministry of Ecology and Natural Resources of the Republic of Kazakhstan, 2023)

3.1.2 Boulevard Ring in Astana

The Boulevard Ring project in Astana aims to make green spaces more accessible to every resident by providing them within walking distance from any location within the city. If the project is fulfilled fully, around 50% of the city's area will be covered by vegetation. The municipality expects Boulevard Ring to provide a place for recreational activities, help to improve air quality and create a cooling effect in the summer. Additional benefits of the project are the promotion of alternative modes of transportation by incorporating bicycle paths and sidewalks totaling 57 km (Danilevskaya, 2018).

This initiative will be implemented in stages to evaluate the effectiveness of the proposed approach, the first stage started in 2018. Nevertheless, there are some challenges to planting the vegetation like the high water table, the acidity of the soils, etc. So, as can be seen from Figure 3, the NDVI of vegetation in Astana, which is an indicator of vegetation's health and density, is quite low (Saginov et al.,2024). This means that for the successful implementation of the Boulevard Ring Project, significant investments would be needed to maximize the potential benefits of planted vegetation, similar to the efforts employed with the Green Belt.

Figure 2. Proposed Plan for Boulevard Ring (Danilevskaya, 2018).

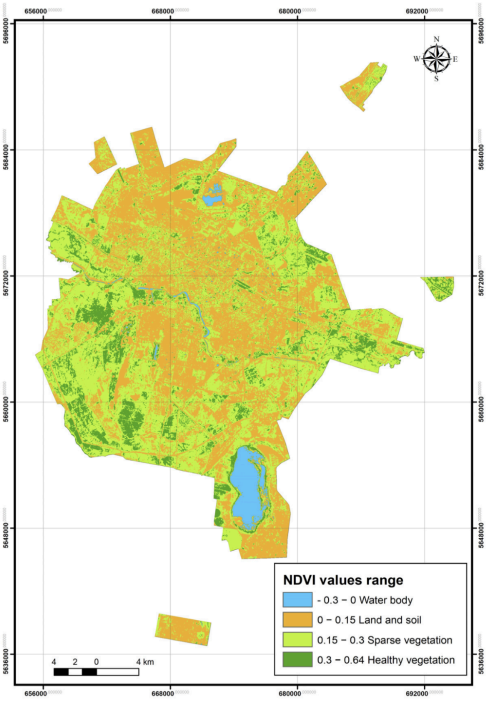

Figure 3. NDVI Value (Saginov et al.,2024)

3.1.3 Barriers of GI in Kazakhstan

The main challenge of the GI initiatives is the need for significant investments for successful adaptation and extensive place-specific research. Overall, low population density decreases the perceived urgency for significant GI investments, leading to favoring economic development over long-term sustainability goals, and most of the effort is concentrated in major cities. It is also evident in the lack of knowledge related to GI implementation in Kazakhstan with almost no scientific papers aimed at evaluating the effect of existing projects and researching the feasibility of future ones.

3.2 India

Urbanization and population growth rates are increasing rapidly in India's major cities. This expansion has led to serious environmental issues like urban heat islands, worsening air quality, and a rise in the frequency of natural disasters.

3.2.1 The Sustainable Development Goals, India

At the UN Sustainable Development Summit in 2015, Prime Minister Narendra Modi noted, “Sustainable development of one-sixth of humanity will be of great consequence to the world and our beautiful planet. It will be a world of fewer challenges and greater hope; and, more confident of its success”. NITI Aayog, the Government of India’s premier think tank, has been entrusted with the task of coordinating the SDGs, mapping schemes related to the SDGs and their targets, and identifying lead and supporting ministries for each target. (Sustainable Development Goals | The United Nations in India, n.d.)

3.2.2 Study area

The major focus is on the rapidly rising Air Quality Index in Delhi. Each year the quality of air deteriorates to hazardous levels posing serious health risks mainly to children, sick and elderly. Delhi’s AQI reached 795 which meant that Delhi is the most polluted city in history (Shakshi, 2024). Figure 4 illustrates the AQI levels between 2021 to 2024, indicating that AQI was at severe to dangerous levels.

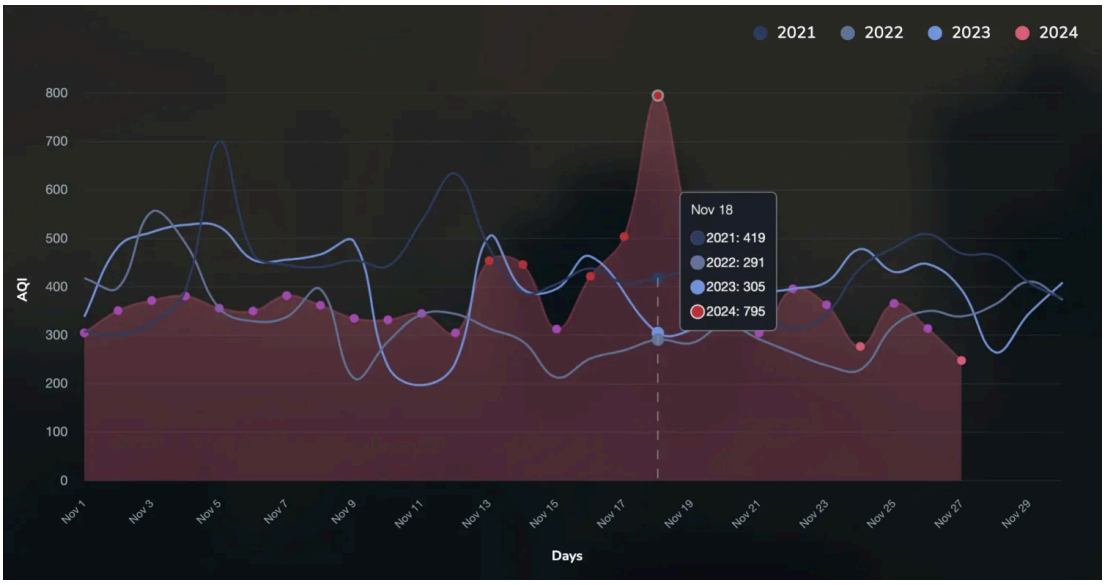

Figure 4: AQI levels of Delhi from 2021-2024

Other urban cities of India like Mumbai, Bengaluru, Kolkata, Gujarat, and Kerala are all experiencing environmental degradation. One of the main causes of these environmental effects has been Bengaluru's and Mumbai's rapidly growing populations.

While Delhi is suffering from high pollution levels, other cities like Mumbai, Bengaluru, Kolkata, Gujarat, and Kerala are also going through the worst environmental conditions. The rapidly rising population in Bengaluru and Mumbai has been one of the key reasons for such environmental impacts. Air pollution is only one aspect of the larger environmental problems

that civilization is facing. Pollution in every form- air, water, noise, plastic, etc poses a massive threat to the ecosystem. Other than pollution, many other aspects are responsible for harming the environment like deforestation, overuse of natural resources, fossil fuels, etc.

3.2.3 Green Infrastructure Initiatives

The Government of India has taken several initiatives to combat climate change and promote sustainable development.

3.2.3.1 Urban forests and vertical gardens to reduce urban heat island effect

Miyawaki Forests in Urban Areas: This technique has been used by cities like Bengaluru, Delhi, and Mumbai to form dense urban forests on limited empty plots of land present in the urban areas. These forests grow up to 10 times faster than traditional plantations, reaching maturity in just 20–30 years. These forests absorb more CO2, filter pollutants, and improve the air quality reducing the urban heat island effect. (Chandramouli, 2019; Singh & Saini, n.d.)

Figure 5: Miyawaki forest at Barapullah site, Delhi

Vertical gardens, Delhi metro pillars: To improve aesthetics and lower air pollution, vertical gardens have been placed atop metro pillars all around Delhi. Drip irrigation is used to water these gardens. Over 15 kg of dangerous heavy metals, 40 tons of greenhouse gases, and 130 grams of airborne particulates can be processed in a four-story vertical garden. Some other examples are flyover vertical gardens in Bengaluru (Bhatia and Bhaskar, 2018).

3.2.3.2 Earthquake-Resilient

Gujarat Earthquake Rehabilitation (Bhuj): After the 2001 earthquake, to build safe structures the use of earthquake-resistant designs, such as reinforced concrete and better masonry methods were implemented. The policy assisted the communities in deciding whether to rebuild their homes in the same location or move them entirely or in part. The total number of eligible houses to be repaired was 929,682 and the total number of eligible houses to be reconstructed was 213,685. By 2003, 882,896 (94%) houses were repaired and 113,271 (53%) were constructed**.**

Flood-Resilient Infrastructure, Gujarat: The Sardar Sarovar Dam was constructed to provide irrigation, hydropower generation, and drinking water supply to the states of Gujarat, Madhya Pradesh, Maharashtra and Rajasthan. It has a storage capacity of 9.5 million acre-feet, which makes it the biggest concrete dam in India and one of the largest in the world. (Gujarat, 2023; Sahoo, Prakash, & Sahoo, n.d.).

3.2.3.3 Urban agriculture

Rooftop Farming Initiatives Kerala: A government-led initiative in which the citizens grow vegetables on the rooftops. This promotes self-sustenance, besides being eco-friendly, and supports sustainable urban farming, efficient usage of space, and fresh produce at hand.

Urban Community Farm Mumbai Grow Trees Movement: It advocates for urban farms in city waste areas to convert them into green spaces. This would reduce the carbon footprint, enhance urban greenery, and purify the air further. (Grow Billion Trees, n.d.).

3.3 Iran, Tehran

3.3.1 Study Area

The Tehran metropolitan boundary covers approximately 5922.95 square kilometers (Iran Statistics Center, 2023), bordered by:

- The Alborz Mountain range to the north.
- Rey County and Shur River to the south.
- The Jajrud River to the east.
- The counties of Shahriar, Robat Karim, and Qods to the west (Dadashpoor, Javadi, & Rafieian, 2013).

This boundary includes agricultural lands, natural reserves, rural and urban settlements, and parts of Tehran's infrastructure. The comprehensive urban plan of Tehran designates this boundary as a "breathing space" for the capital city (Dadashpoor, Javadi, & Rafieian, 2013). Greater Tehran is situated in the northern-central region of Iran. The city's average altitude is approximately 1,280 meters above sea level, spanning an area of around 750 square kilometers (Traffic Organization of Tehran Municipality, 2017; Mojtehedzadeh, 2019). Its maximum length and width are approximately 45 and 27 kilometers, respectively. Figure 6 illustrates the geographical extent of Tehran and its location.

Figure 6. Tehran is faced with the Northern mountains, which are a boundary for humidity and precipitation coming from the north and western north (Google Earth, 2024).

3.3.2 Challenges to Sustainable Urban Development and GI in Tehran

Tehran faces significant challenges in achieving sustainable urban development, driven by rapid population growth, uncontrolled urban expansion, and ecological degradation. These issues are exacerbated by human activities and geographical vulnerabilities, making immediate intervention essential for ensuring environmental stability and fostering a sustainable future.

Population growth has been a major contributor, with settlements in Tehran's boundary area experiencing a 200% increase between 1986 and 2006, compared to a 30% rise within the city. This growth has placed immense pressure on infrastructure and resources and continues to rise steadily (Figure 7). Additionally, unregulated urban expansion has destroyed agricultural lands and gardens, intensifying pressure on environmental resources.

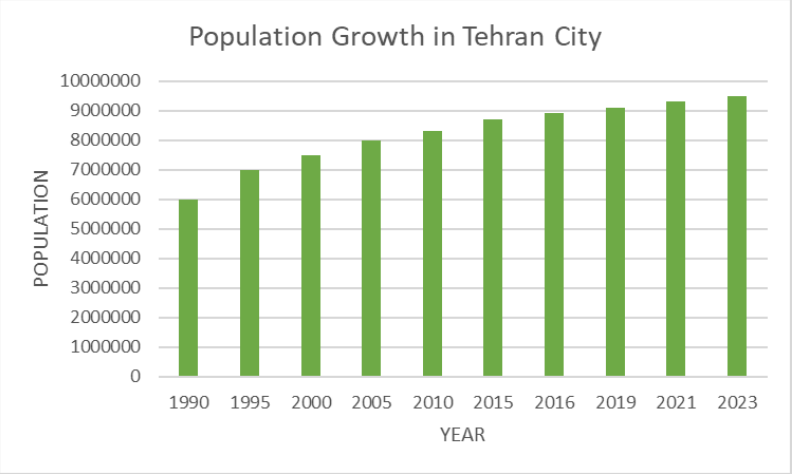

Figure 7. Tehran's population growth (Iran Statistics Center, 2023).

Environmental degradation caused by poorly planned construction and human activities has further reduced the area's ecological quality. The presence of active fault lines and the region's geological sensitivity make unregulated development hazardous (Ritz et al., 2012). Furthermore, the lack of green spaces in Tehran underscores the need for preserving natural and protected areas to maintain ecological balance and improve urban quality of life (Dadashpoor, Javadi, & Rafieian, 2013).

3.3.3 GI Projects in Tehran

3.3.3.1 The Green Belt

Tehran's Green Belt encircles the city, creating a buffer zone that limits urban sprawl while improving environmental quality. By balancing temperature and humidity and reducing CO_2

levels, the belt plays a crucial role in mitigating climate change impacts (Figure 8). The plan divides Tehran's boundary into four functional zones: the **Protective Zone** (45.88%) conserves natural resources; the **Agricultural Zone** (27.82%) promotes sustainable agricultural practices; the **Urban Zone** (19.6%) supports controlled urban growth; and the **Infrastructure Zone** (6.7%) accommodates essential facilities (Dadashpoor, Javadi, & Rafieian, 2013).

Figure 8. The green belt aims to encircle Tehran city to mitigate climate change impacts and decrease the air quality index by providing green areas (Dadashpoor, Javadi, & Rafieian, 2013).

Table 1 compares the current and proposed areas for these zones, highlighting a significant increase in the protective and agricultural zones, underscoring a shift toward ecological preservation and sustainable development. The protective zone area has more than doubled, from 21.58% to 45.88%, emphasizing land conservation. Similarly, the agricultural zone has expanded by 65%, ensuring food security and sustainable land use. Urban and infrastructure zones have grown moderately (25%), addressing demographic needs without encroaching on sensitive areas.

Table 1: Comparison of Functional Zones in Current and Proposed Conditions (Dadashpoor, Javadi, & Rafieian, 2013).

Category	Current Area (km^2)	Current Percentage (%)	Proposed Area (km^2)	Proposed Percentage (%)
Protective Zone	1278.6	21.58	2718.05	45.88
Agricultural Zone	1044.74	17.63	1647.51	27.82
Urban Zone	838.21	14.15	1160.26	19.6
Infrastructure Zone	288.69	4.9	397.13	6.7

The Green Belt contributes significantly to ecological balance by prioritizing protective and agricultural zones over urban expansion, ensuring environmental preservation and improved air quality (Dadashpoor, Javadi, & Rafieian, 2013). Key components include parks and green

spaces such as Sorcheh Hesar National Park (2,500 hectares) and Chitgar Forest Park (1,000 hectares), which reduce the air quality index and CO_2 emissions.

The belt stabilizes soil, mitigates sandstorms, and enhances air quality. Additionally, it offers recreational facilities like walking trails and cultural spaces, fostering public interaction with nature (Dadashpoor, Javadi, & Rafieian, 2013; Traffic Organization of Tehran Municipality [TTO], 2017).

3.3.3.2 Artificial Chitgar Lake (Balancing Benefits and Challenges)

Chitgar Lake, also known as the Lake of the Martyrs of the Persian Gulf, is the largest artificial lake in the Middle East, spanning 132 hectares and containing 6.9 million cubic meters of water. Constructed in 2013, it was designed to enhance ecological services and contribute to Tehran's urban modernization efforts (Sadd Tunnel Pars Consulting Engineers, 2012; Zeyaeyan et al., 2017).

Figure 9. The land use changed during the construction of the Chitgar Artificial Lake (Google Earth, 2024).

Ecologically, the lake supports biodiversity, attracting 32 bird species (10 new to Tehran) and fostering a balanced aquatic ecosystem with introduced fish species. Its cooling and humidifying effects help mitigate the urban heat island phenomenon, while water quality management prevents algae blooms (Emam et al., 2016; Sadd Tunnel Pars Consulting Engineers, 2012). Socially, the lake serves as a recreational hub, offering activities such as boating and cycling, boosting local investments, and enhancing community well-being (Emam et al., 2016).

Despite these benefits, the project faces challenges. Increased traffic congestion, waste management concerns, and environmental risks like eutrophication and water loss require consistent maintenance. Additionally, its reliance on scarce water resources in Tehran raises concerns about long-term sustainability. Without effective management, Chitgar Lake risks becoming a case of "green gone wrong" (Akhshik et al., 2020; Khezr Seddigh & Rafipour, 2015).

Figure 10. Recreational Opportunities of the lake (Islamic Republic News Agency [IRNA], 2023).

3.3.3.3 Green Roofs and Structure Projects

The main issue in this regard is that only a limited number of residential, commercial, or public buildings are equipped with these features, and their density in the city is very low. The municipality, by offering various incentives such as reduced construction permit taxes and providing financial support to green construction, can create a broad foundation for the growth of green roofs in the city. Some of the implemented projects are as follows:

Sharifi-ha House

Located in Tehran's Darrous neighborhood, the Sharifi-ha House is a seven-story residential building designed by Next Office, led by architect Alireza Taghaboni. Completed in 2013, the house is renowned for its rotating rooms that pivot 90 degrees, transforming the façade based on seasonal needs or functional requirements (ArchDaily, 2014).

The house incorporates three rotating wooden-clad steel-framed boxes, which extend outward to create open terraces in summer or retract to form a closed façade in winter, which can be seen in Figure 11. This adaptability draws inspiration from traditional Iranian architecture, addressing Tehran's climatic variations.

Figure 11: Façade of Sharifi-ha House (ArchDaily, 2014).

Figure 12 illustrates a schematic representation of Sharifi-ha House's rotating rooms and structural design, showcasing the integration of movable units and void spaces for flexible functionality.

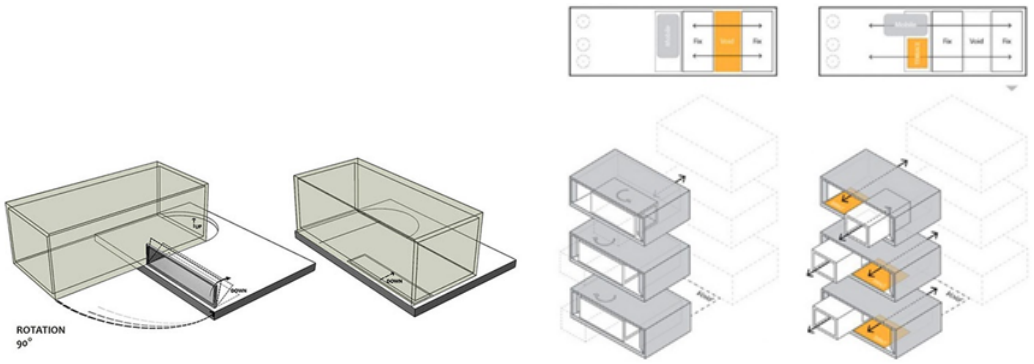

Figure 12: Rotating Mechanism and Structural Layout (ArchDaily, 2014).

Sharifi-ha House has received the Grand Architect Award (2014) and the Middle East Award (MEA, 2014) for its innovative and flexible design, which integrates green infrastructure into an urban context (ArchDaily, 2014).

Megapars Project

Features 18,000 square meters of green space. Includes intelligent irrigation systems and water recycling. Creates hill-like slopes and flowing water for a natural aesthetic.

National Library of Iran

62,000 square meters with integrated green roofing. Enhances the environmental performance of the building while providing aesthetic and functional benefits (Goharipour & Firoozabadi, 2022).

Earings House

A residential project designed with an eco-friendly focus, incorporating natural ventilation systems, rooftop gardens, and solar panels (Archline, n.d.).

Figure 12: The Earings (Gushvareh) House features an innovative design that integrates wooden panels for privacy and natural ventilation, complemented by semi-open spaces that provide cozy areas for relaxation and interaction (Archline, n.d.).

4 Discussion

Comparative analysis underscores the potential for cross-regional learning. Despite unique challenges, these initiatives share a common goal of fostering ecological harmony and urban well-being. Strategic investments, policy alignment, and community involvement are essential for maximizing the benefits of green infrastructure in urban settings. Government policies must support green infrastructure initiatives with proper funding, frameworks, and partnerships. Local communities must be actively involved to ensure the long-term adoption and maintenance of sustainable practices.

Table 2 presents a comparative overview of socioeconomic and environmental metrics across three selected countries: Kazakhstan, India, and Iran. This table highlights key data points illustrating the diverse environmental and economic contexts in which green infrastructure (GI) projects operate, emphasizing the varying priorities and challenges for each region.

Table 2: Socioeconomic and Environmental Metrics of Selected Countries (World Bank, 2024; United Nations, 2024).

Country	Population	Air Quality Index (AQI)	GDP (USD Trillions)	GDP per capita (USD)	Average Climate
Kazakhstan	20 million	Moderate (50-70 AQI)	0.22	12 919	Extreme Continental (-40°C to +40°C)
India	1.45 billion	Poor (150+ AQI in major cities)	3.38	2 485	Tropical and Semi-Arid
Iran (Tehran focus)	91 million	Poor (120-180 AQI)	0.39	4 503	Semi-Arid with Hot Summers

Table 3 outlines key green infrastructure projects by country, showcasing notable initiatives in Kazakhstan, India, and Tehran. The table also describes the key features of these projects, such as climate stabilization in Kazakhstan, pollution reduction in India, and biodiversity conservation in Tehran. These projects demonstrate how GI adapts to address specific environmental and societal challenges unique to each region.

Table 3: Key Green Infrastructure Projects by Country

Country	Projects	Key Features
Kazakhstan	Astana Green Belt, Boulevard Ring	Climate stabilization, desertification control
India	Vertical Gardens, Urban Forests	Pollution reduction, biodiversity, urban cooling
Tehran (Iran)	Chitgar Lake, Tehran Green Belt, Green Roofs	Heat mitigation, air purification, biodiversity conservation

GI's strategies in Iran, India, and Kazakhstan address their unique environmental and societal priorities. Iran emphasizes urban revitalization and recreational spaces to combat air pollution and urban sprawl, while India focuses on biodiversity and sustainable transit systems. Kazakhstan prioritizes climate adaptation and desertification control. These approaches demonstrate GI's flexibility in addressing region-specific needs.

Despite differing contexts, all three countries face common challenges, including rapid population growth, uncontrolled urban sprawl, and resource strain. Tehran and Delhi suffer from severe air pollution and overburdened infrastructure, while industrialization and urban expansion have intensified pressures in cities like Almaty.

To address these challenges, GI must be integrated into urban planning for new developments. Financial incentives, such as subsidies and tax benefits, can encourage investment in sustainable projects. Public engagement through awareness campaigns is critical for long-term success, while international collaboration can facilitate knowledge sharing and resource optimization.

5 Conclusion

Green infrastructure is integral to creating sustainable, climate-resilient urban environments. By addressing environmental challenges and enhancing the quality of life, GI represents a transformative approach to urban development, which can be adapted to local needs. Kazakhstan’s expansive green belts highlight the role of GI in mitigating extreme climates, while India’s emphasis on biodiversity and sustainable transit showcases scalable models, Tehran demonstrates innovative designs with projects like Sharifi-ha House and Megapars, this further emphasizes the significance of green infrastructure integration to combat climate-related issues.

Environmental degradation is an ongoing and complex issue. Despite being designed to reduce development and enhance air quality, Tehran's green belt is struggling due to rising urban demand. Similar issues include water contamination, air pollution, and a lack of green space in Indian cities. Kazakhstan suffers from urban pollution even though due to lower population density the issue does not seem as urgent.

Climate change further complicates these challenges. Kazakhstan suffers from extreme temperature fluctuations, and Tehran is susceptible to earthquakes and floods, cities in India face increasing pollution and temperature. Green infrastructure, such as Kazakhstan's Green Belt initiative, India's vertical gardens, and Iran's Chitgar Lake, is to mitigate the effects of climate change. Green belts, rooftop gardens, and water recycling are examples of sustainability projects currently being implemented in all three regions; however, growing urbanization and inadequate enforcement of laws are hindering development.

In conclusion, even though India, Iran, and Kazakhstan are tackling urban and environmental challenges with sustainability initiatives and green infrastructure, more efficient urban planning and robust environmental legislation are required to ensure a sustainable future.

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