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URBAN ENVIRONMENTAL MANAGEMENT: ECOLOGICAL AND ECONOMIC ASPECTS OF CREATING GREEN INFRASTRUCTURE

Abstract: *The urban environment is primarily understood as a combination of natural, biological, climatic, social, and economic factors that affect the quality of life and well-being of the population living in urban areas. This includes air and water quality, soil conditions, biodiversity, noise levels, climate change, and many other factors. Improving the urban environment and identifying and assessing performance indicators are key aspects of urban environmental management. This article discusses the main areas of urban environmental management and their effectiveness.*

Keywords: *green infrastructure, urban ecology, environment, environmental sustainability, ecological environment,* level of greenery

Introduction. In the modern world, the rapid development of cities has a negative impact on the environment. As a result of urbanization, the amount of waste in cities is increasing, which, in turn, leads to air, soil, and water pollution. These issues disrupt the ecological balance and reduce biodiversity. At the same time, noise pollution in urban areas is rising, negatively affecting people's psychological and physical health. Climate change further exacerbates the heat island effect in cities and increases the risk of extreme weather events. These factors pose a serious threat to the health and lifestyles of urban residents. Therefore, it is necessary to implement effective measures to ensure ecological sustainability and protect the environment. This situation has, in fact, become one of the most pressing issues of the 21st century. The causes of urban environmental pollution can be attributed to the increasing urban population and the low level of environmental awareness among residents. As people treat nature, nature responds accordingly—meaning that the most polluted cities and those suffering the most from the consequences are inhabited by city dwellers themselves. An alternative solution to this problem is urban environmental management, which involves organizing green infrastructure and creating urban green spaces.

The President of the Republic of Uzbekistan, Shavkat Mirziyoyev, in his speech at the session of the Legislative Chamber of Parliament, specifically addressed issues related to ecology and climate change. According to the head of state, air and water pollution, soil erosion, desertification, and the indiscriminate use of fossil fuels contribute to global warming, an increase in natural disasters,

and environmental and public health damage. In response, Uzbekistan launched the nationwide “Green Space” project three years ago. In cooperation with neighboring countries, the Regional Climate Strategy was implemented, and the Central Asian University for the Study of Environment and Climate Change was established in the capital. Additionally, Uzbekistan initiated two key resolutions adopted by the UN on these matters.

At the same time, “green” energy is becoming one of the driving forces of the country’s economy. Based on public opinions and suggestions, 2025 was declared the “Year of Environmental Protection and the Green Economy” [1]. This year, key priorities include the introduction of “green” technologies, water conservation, a significant increase in green areas, mitigating the consequences of the Aral Sea tragedy, addressing waste management issues, and, most importantly, improving public health. Furthermore, enhancing the urban environment from both ecological and economic perspectives is an increasingly urgent matter.

Methods. This article uses territorial, historical geographical analysis, geographical comparison, comparative description and cartographic methods. The information is based on official websites and official statements, in particular, data from the State Statistics Agency. The map was developed based on digital satellite data.

The level of study of the topic. Theoretical and methodological issues of urban geography and geourbanization have been scientifically studied by foreign and local experts. In particular, in the research on urban geography and urbanization problems, the research and scientific works of foreign researchers J. Gibbs's theory of "Stage Urbanization" [15], Frederick Starr's "Modular Construction" concession, T. Kontuli and H. Dearden's concept of "Differential Urbanization", as well as the research and scientific works of specialists of the Russian geourbanization scientific school such as G.M. Lappo [8], Y. N. Pertsik [11], V.G. Davidovich [4], Y.G. Saushkin [14], B.S. Khorev [18] are considered significant.

In addition, the works of American scientists such as Richard Florida[5], Edward Glaeser, David Harvey, Saskia Sassen, Allan G. Noble are also widely used by today's researchers.

The research and scientific works of O.B. Ata-Mirzaev [3], A. Rafikov [13], T.I. Raimov, A.S. Soliev [16], A.A. Qayumov [15], T.N. Mallabaev , Z.H. Rayimzhanov, Z.T. Abdalova [2], S.K. Tashtaeva[16,17] M.M. Egamberdieva [17], S.S. Zokirov [19], Z.N. Tojieva, etc. on the economic geographical study of cities in Uzbekistan are considered significant.

Goals and objectives. The purpose of this article is to study the economic and ecological aspects of the impact of green spaces on the urban environment. To achieve this goal, the following tasks have been defined:

- to identify the main factors in the formation of the urban environment;
- the economic significance of urban green spaces;
- the role of urban green spaces in maintaining ecological stability;
- to determine and assess the amount of green spaces in the city of Namangan.

Results. The urban environment can be examined from various perspectives, primarily including ecological, economic, socio-psychological, religious, cultural, political, and demographic aspects (Figure 1). These factors serve as the main components shaping urban life. One of the defining characteristics of the urban environment is its high population density. This density results from a large number of people migrating to cities from different regions for education, employment, and other purposes, alongside permanent residents. Additionally, buildings and residential areas are densely situated. A well-developed transport system, as well as access to education, medical institutions, and service facilities, are key factors that determine the advantages of urban life.

When studying the urban environment from an *economic perspective*, several challenges arise. One of them is that for a city to develop its own unique environment, it must be economically advanced, with a stable population, technological progress, employment opportunities, high income levels, reasonable housing prices, and well-developed infrastructure. Collecting comprehensive and accurate data on these indicators requires significant effort and resources. Additionally, economic security—having a high income level—is essential for a stable urban life.

The socio-psychological state of a city is largely determined by its population density, as well as the character, mentality, customs, and traditions of its residents. For example, by comparing the psychology of people living in an ancient city with those in a highly modernized city, one can observe significant differences in behavior, lifestyle, and social interactions.

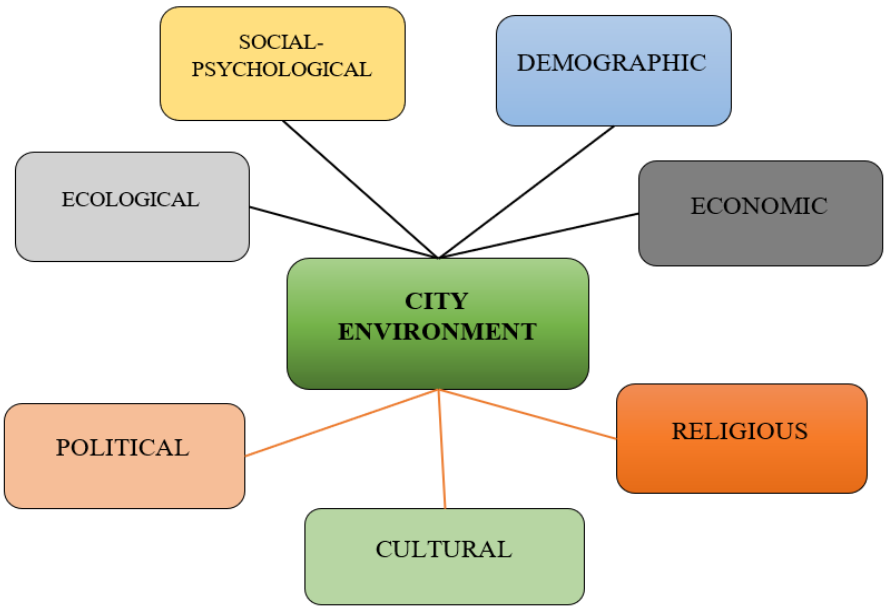


Figure 1. Aspects of urban environment research [7]

Note: The drawing was created by the author

The ecological environment of a city encompasses both natural and man-made elements and their interactions. It includes the relationship between human-made structures—such as infrastructure, buildings, and roads – and the natural environment, including plants, animals, and ecosystems. The urban ecological environment is often influenced and altered by human activities such as urbanization, industrialization, and population growth. These processes can result in habitat loss, biodiversity decline, pollution, and changes in the local climate.

A key component of the urban ecological environment is the concept of urban ecosystems. These are self-regulating systems within cities that provide essential services to residents. Urban ecosystems include green spaces such as parks, gardens, and roadside trees, as well as water bodies like rivers, lakes, and ponds. Green spaces play a crucial role in maintaining ecological balance, improving air quality, regulating temperature, and enhancing overall urban sustainability.

The demographic environment of a city refers to the composition and characteristics of its population. It plays a crucial role in urban planning, helping policymakers, researchers, and businesses understand the city's social structure and potential development opportunities. Key demographic factors include population density, birth and death rates, marriage and divorce rates, family composition, age structure, ethnic and cultural diversity, population size, education levels, and migration patterns influenced by cultural and socio-economic changes.

The religious environment of a city significantly shapes its cultural, social, and historical landscape. Many cities are home to followers of multiple religions, including major world faiths such as Christianity, Islam, Judaism, Hinduism, Buddhism, and Sikhism. This religious diversity contributes to a rich and inclusive urban environment. Cities often feature a variety of religious landmarks, including churches, mosques, synagogues, gurdwaras, and monasteries. These places of worship serve not only as sacred spaces but also as cultural and social centers. Religious values influence various aspects of urban life, shaping social norms, education, charitable activities, and moral standards.

The political environment of a city refers to the overall political landscape and the development of local governance. It includes factors such as affiliations with ruling political parties, prevailing ideologies, public movements, and key state policies. Additionally, it encompasses administrative structures, city governments, and buildings of state significance.

The cultural environment of a city shapes its identity and cultural heritage, playing a crucial role in forming the community’s collective culture. It includes various elements such as art, history, traditions, celebrations, festivals, and social norms. Cities often have a rich artistic and architectural heritage that reflects their historical influences. This is evident in paintings, sculptures, and iconic buildings

that enhance the city's visual appeal. Museums, galleries, and public art installations further enrich the cultural landscape. Cities with a vibrant cultural environment typically host numerous institutions and organizations dedicated to cultural activities, including theaters, music academies, literary societies, and dance troupes. [7]

Urban environmental management requires an integrated approach based on the following factors:

- Considering factors that negatively impact the environment when planning urban development projects.
- Developing measures to prevent and reduce pollution of soil, water, and air from industrial, transportation, and household waste sources.
- Planning adaptation strategies for adverse weather conditions, climate change (extreme heat, severe cold), and natural geographical phenomena.
- Incorporating the opinions of local residents in urban environmental decision-making and involving them in the implementation of policies and regulations.
- Preserving the natural environment within the city and minimizing water, air, and soil pollution through the development of green infrastructure.
- Regularly developing, monitoring, and evaluating strategies for sustainable urban environmental management.

Based on these factors, it is possible to create a healthy and sustainable urban environment in the future. Green infrastructure takes various forms, such as parks, ornamental trees and flowers along streets and roads, hanging gardens, green roofs and walls, as well as aesthetically appealing green spaces (greenways and trails) arranged linearly along rivers, lakes, and canals in large cities.

To develop green infrastructure, urban planning projects must first establish the location, external design, and a detailed implementation plan. Identifying the most effective areas for green spaces requires consideration of engineering and geographical survey results. The size of the green space and the necessary technical services are then determined accordingly. Additionally, public participation plays a crucial role in green space management. To achieve this, it is essential to foster ecological literacy and environmental awareness among the population.

The ecological significance of green infrastructure lies primarily in the role of green plants in purifying urban air. During photosynthesis, plants reduce harmful gases in the urban atmosphere, helping to control air pollution [11]. This is why trees such as spruce and pine are commonly planted along streets and roadsides—they effectively absorb harmful gases like CO_2 emitted from vehicles, industry, and other sources while producing oxygen.

In addition to trees, vertical greenery in the form of hanging gardens on residential building walls further contributes to air purification and cooling effects. Parks and botanical gardens not only serve as spaces for cultural recreation but also play a key role in reducing fatigue and stress among city dwellers. The presence of well-developed service sectors within these parks enhances their functionality and

accessibility. Large urban parks, which embody the natural beauty of the environment, attract people of all ages. Notable examples include Dubai's "Miracle Garden" and Singapore's "Gardens by the Bay," both of which showcase how green spaces can enhance the urban environment while maintaining ecological balance.

Furthermore, urban green infrastructure preserves biodiversity and helps prevent the deterioration of the microclimate. By incorporating greenery, cities can mitigate the urban heat island effect, regulate temperatures, and support sustainable living. Overall, green infrastructure plays a vital role in improving urban environments, contributing to both ecological health and human well-being.

The economic importance of green infrastructure is that it provides a wide range of economic benefits:

reduces infrastructure costs; thereby, it can reduce the need for expensive urban pollution control devices,

prevents rapid warming or cooling of urban air; that is, it can stabilize it (through which urban residents use less heating or cooling devices in their homes and organizations),

increases property values: according to studies, residential areas near green spaces are distinguished by their quality of life, aesthetic appeal compared to others and are more desirable to buyers and tenants. This leads to an increase in the cost of housing. For example, it was found that the cost of residential buildings around the Afsonalar Vodiysi park in Namangan is 1.5-2 times more expensive than in other parts of the city.

job creation: through the development and support of green infrastructure, jobs can be created in landscaping, construction and other related sectors. Green infrastructure projects can provide employment to local workers and contribute to their economic development. For example, according to the Namangan City Improvement Department, more than 270 people are currently employed.

tourism development: Green spaces attract both tourists and residents. They provide residents with opportunities for recreation and social interaction. Parks and green spaces allow local residents to earn economic income by supporting businesses related to tourism and recreation.

Based on the data, a study was conducted in the city of Namangan, Namangan region, using statistical analysis. According to the results of the study, the total area of Namangan city is 168.3725 sq. km, of which green areas account for 149.8493 sq. km. When determining the total amount of green areas available for public use, the percentage of areas with no greenness, as well as those with low, medium, and high greenness indicators, was identified (Table 1).

Table 1

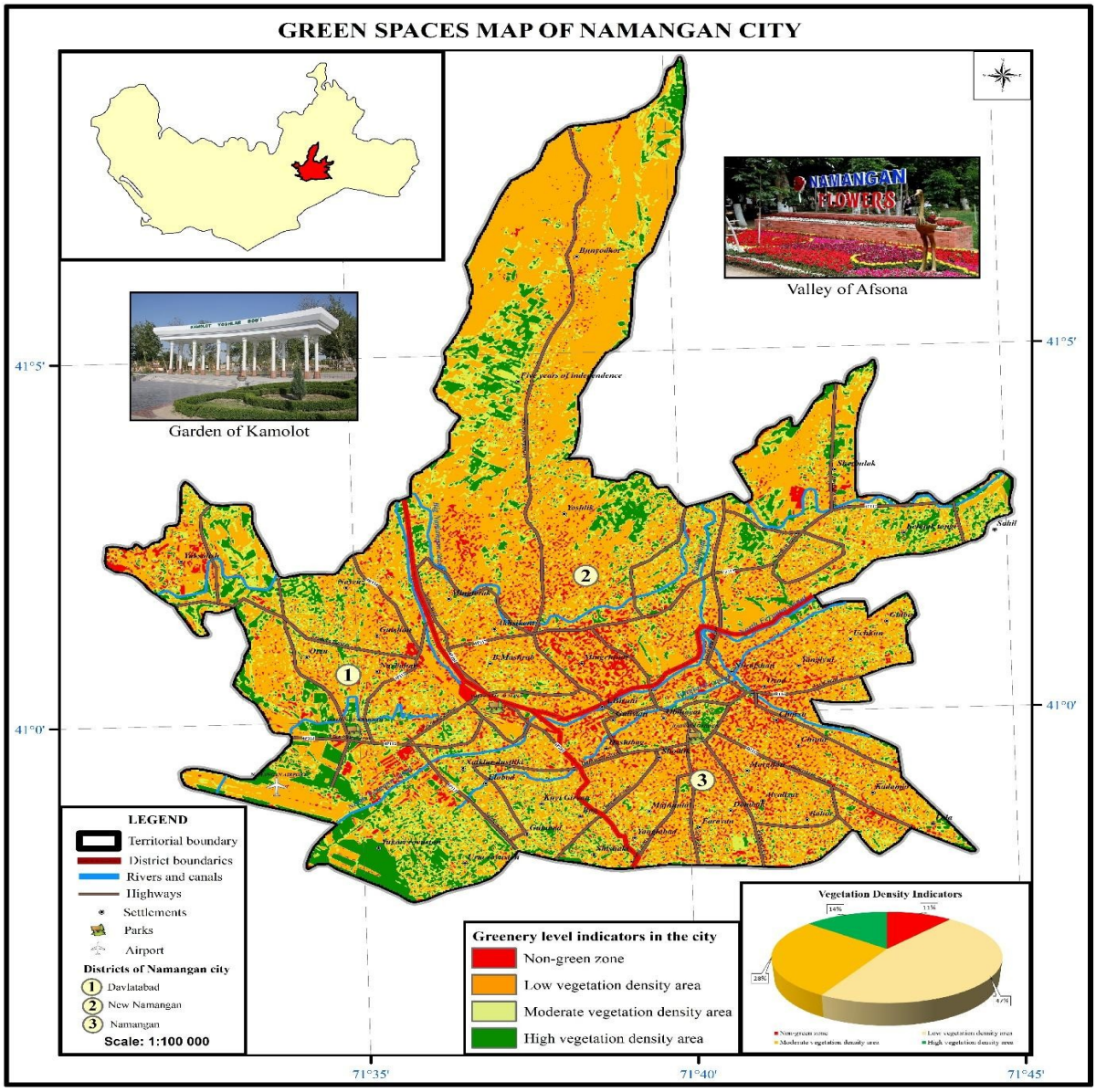
Indicators of the level of greenery in Namangan

№	City greenness levels	Amount (%)	Area (sq km)

1	An area without greenery	11%	18.5207 sq km
2	Low-green area	47%	79.1339 sq km
3	Area with average level of greenery	28%	47.1436 sq km
4	Area with high level of greenery	14%	23.5718 sq km

Note. The table was created by the author

Namangan city is divided into 3 city districts: Davlatabad, “New Namangan” and Namangan cities. Green spaces are not just green gardens and parks, but also ornamental trees and plants, green areas on streets and sidewalks. According to the data obtained, it was determined that more than 77 sq km of green space falls on “New Namangan”, more than 57 sq km on Davlatabad district, and more than 34 sq km on Namangan city. Davlatabad district is the leader in terms of the high level of greenery. Areas with no greenery in the city occupy 11% of the city, mainly occupied by buildings, structures, cultural and historical sites, and residential buildings. Areas with a low level of greenery make up 47% of the city. 28% of the city area is occupied by medium-level green spaces. It was determined that green spaces account for 14% of the total area of the city, or more than 23 sq km. Based on the data obtained, a map of green spaces in Namangan was created using ESRI's ArcGIS 10.8 software (see Figure 2).



Note. The map was created by the author

Maps and tables developed based on spatial data revealed that the Davlatabad district of Namangan city has a larger area of green spaces that are conducive to air quality, health, and living comfort than other parts of the city (Figure 2).

One of the centers of attraction for the city's population is the parks, and there are four main large parks in the city: the Valley of Legends, the Zakhiriddin Mukhammad Babur National Park, Mashrab, and Kamolot Gardens. Namangan becomes the most popular place in the Republic in May and June. The reason is that the "Flower Festival" takes place for about a month. Namangan residents prepare for this holiday and display all kinds of flowers. In 2024, the 63rd anniversary of the holiday was widely celebrated. The festival is visited not only by residents of Uzbekistan but also by flower lovers from the Central Asian region,

as well as by interested people from countries such as Russia, China, and South Korea. Green infrastructure helps the population in cities adapt to climate change by reducing the impact of extreme weather events on the city. Rapid urban climate adaptation will help protect infrastructure such as businesses, factories, and plants from climate-related risks.

Holding festivals like this in the city, in addition to its ecological benefits, brings many economic benefits and is an important factor in further increasing the city's economic opportunities and tourism potential.

Conclusion. The environmental and economic aspects of green infrastructure in urban environmental management are closely related and complementary processes. As discussed in this article, green infrastructure contributes significantly not only to environmental improvement but also to the economic development of cities.

1. From an environmental perspective, green infrastructure provides significant benefits by improving air and water quality, increasing biodiversity, adapting to climate change, and reducing the urban heat island effect. These benefits not only enhance the overall state of the environment but also improve residents' health and quality of life. The presence of green spaces reduces stress, increases physical activity, and promotes overall well-being.

2. From an economic perspective, green infrastructure offers long-term cost savings and revenue opportunities. Reducing the need for gray infrastructure, increasing real estate values, developing tourism, and creating new jobs are all economic benefits of investing in green infrastructure. Additionally, the use of green technologies and innovations contributes to energy conservation and the efficient use of resources.

3. However, several important aspects must be considered for the effective management of green infrastructure. The importance of good planning and design, adequate funding, the training of qualified personnel, and public engagement should be emphasized. It is crucial to balance environmental and economic considerations in the design and implementation of green infrastructure. Excessive environmental requirements may be economically unfeasible, while an overemphasis on economic benefits can negatively impact the environment.

In conclusion, the creation and management of green infrastructure are essential components of urban environmental management, providing long-term environmental and economic benefits. Through effective management and smart planning, we can make cities more sustainable, prosperous, and livable. In the future, research into the development and effectiveness of green infrastructure should continue, and its importance in public policy should be further strengthened.

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