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The human ecological significance of urban green spaces

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Abstract

The proportion of the world's population living in cities is steadily increasing, intensifying pressure on natural resources and urban ecosystems, particularly in historically developed large cities. Urbanisation poses significant environmental challenges, including biodiversity loss, habitat fragmentation, and deteriorating urban climate conditions. This study aims to highlight the role of sustainable urbanisation and urban green infrastructure in mitigating the negative environmental and social impacts of urban growth, with a particular focus on biodiversity conservation, ecosystem services, and human well-being. The paper is based on a comprehensive review and synthesis of international and Hungarian scientific literature, policy documents, and urban planning concepts related to sustainability, green spaces, biodiversity, and urban ecology. Comparative examples from European cities are used to illustrate best practices in integrating green areas and ecological networks into urban structures. The analysis demonstrates that urban green spaces – regardless of whether they are of natural or artificial origin – provide essential ecological, climatic, social, and health-related functions. Well-connected green networks reduce habitat fragmentation, mitigate urban heat island effects, improve air quality, and contribute to physical and mental health. Furthermore, large, integrated green areas can significantly enhance urban sustainability and resilience. Preserving and expanding urban green spaces and ecological networks is a key prerequisite for livable, climate-adaptive, and healthy cities in the context of ongoing urbanisation.

Keywords

urbanization, green spaces, urban development, biodiversity, sustainability

1. Introduction

An increasing proportion of the world's population lives in cities. In 2024, 58% of the world's population lived in urban areas, while in Europe this proportion was even higher: in 2023, 76% of Europe's population resided in urban areas (World Bank, n.d.). Contemporary urbanization threatens both natural values and resources, and effects are the most significant in large cities established a long time ago (Goudie and Viles, 1997).

In order for the continuously growing urban population to exist in a livable environment, it is necessary to prioritize sustainable urban development as a settlement development goal. The primary objective of sustainable urban development is to create an environmental, economic, and social balance in cities through the efficient use of natural resources. The common goal of sustainability measures is to ensure economic and social development through the application of environmentally friendly technologies and the improvement of environmental conditions.

Therefore, concept of sustainability can be divided into economic, social, and environmental sustainability components. The first concerns the equitable distribution of resources, the second relates to public and civic participation, while the third focuses on the protection of natural resources. Sustainability can only be achieved through the parallel and simultaneous implementation of these three dimensions (Akkoy et al., 2025) (Figure 1).

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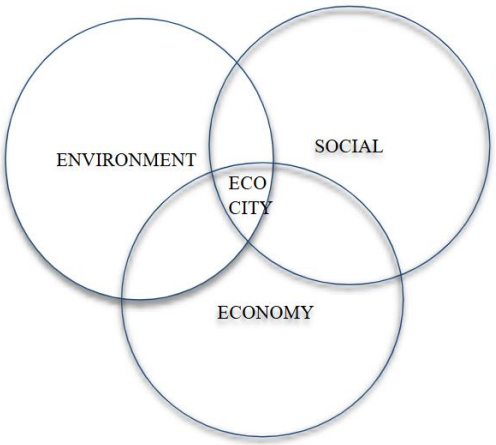

Figure 1. Dimensions of sustainable development
(based on Akıncı, İ. and Pouya, S., 2019: 97)

Sustainability in a settlement can only be achieved through appropriate planning based on ecological principles. To this end – among other things – biodiversity must be protected by preserving the green areas surrounding the city and by protecting and restoring local ecosystems and wetlands (Miller and Spoolman, 2008). Furthermore, it is important to be aware of the concept of sustainable urban development and its human ecological foundations. Green developments, as outlined in the environmental programs or urban development concepts of Hungarian cities, are gradually being implemented. However, there is still much to be done in this area. Our cities are characterized by increasing traffic, shrinking green spaces, and asphalt-covered roads, which need to be counterbalanced by sustainable development initiatives. There are many European best practices for these, which Hungary can also adopt. Furthermore, it is crucial to draw attention to the fact that the significance of urban green spaces is not only an abstract concept of environmental protection and nature conservation, but it also has practical importance for ensuring human well-being and a healthy environment.

This study explores the relevant literature to show the importance of green surfaces and areas in cities, and thus in sustainable urban development. The aim is to present the reasons for creating so-called green cities, and to show their significance from a human ecology perspective. For illustration, some practical examples of sustainable urban development from major European cities are also presented. The rest of the paper is organized as follows. Section 2 clarifies the fundamental concepts related to sustainable urban development. Section 3 offers an overview of the different functions of green areas, while Section 4 describes best practices from Europe. Section 5 concludes the article.

2. Background

This section discusses the most important concepts related to sustainable urban development. These include green surfaces and green areas, biodiversity and green cities.

It is important to clarify the difference between *green surfaces* and *green areas*, as these terms are often used interchangeably. The totality of vegetation-covered areas within settlements is referred to as *green surface* (Molnár Zs., 2020). The surface of settlements can be divided into biologically active (green surfaces + water surfaces) and biologically inactive (built-up, paved) parts. In contrast to green surfaces – which represent a functional space – *green areas* constitute a land-use category to which specific legal regulations apply. Green areas form part of the green surface system and include only public spaces. It is important that they are accessible without barriers from public roads and squares. Furthermore, they may only be used for sports and recreational purposes. Green areas include public parks, public gardens, tree-lined public spaces, playgrounds, and dog parks. It is worth noting that private gardens are no longer considered green areas, only green surfaces, since they do not function as community spaces (Levegő Munkacsoport, n. d.).

It is also important to interpret the concept of biodiversity, as it is widely used from political decision-making to scientific discourse. However, this concept is still not sufficiently well known to the general public, and thus it is generally attributed aesthetic or emotional value rather than functional or economic value. Biodiversity is the variety of living things – animals,

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plants, fungi and microorganisms – that live in one area (Hancock, n. d.). Urbanized green areas increasingly serve as sites for the preservation of native biodiversity. As the spatial extent of urban areas continues to grow, natural habitats within settlements are becoming increasingly fragmented. Urban infrastructure – roads, real estate developments, and other linear infrastructure – disrupts the areas of natural flora and fauna. This disruption gradually degrades local biodiversity (Kisvarga, 2023). Additionally, the genetic stock of organisms living within these fragments also deteriorates.

The increase of green spaces and the protection of biodiversity cannot be understood without the concept of the green city. A green city, or in other words, a sustainable city or even eco-city, is an urban enclave where construction, planning, and operation prioritize the preservation of the natural environment while also ensuring the social, economic, and health well-being of its residents (Loughlin, 2024). The administrative framework for making cities more sustainable is defined within the European Union by the Green City Accord (GCA). This is a movement aimed at European cities that supports the creation of greener, cleaner, and healthier urban environments (EC, 2020).

3. Functions of green surfaces and areas

It is important to emphasize that from a settlement ecology perspective, it is almost irrelevant whether urban green surfaces are of natural or artificial origin, as the plants forming green surfaces provide various ecosystem services. They greatly contribute to improving environmental quality, mitigating the negative impacts of human activities, and enhancing aesthetic value (Kisvarga, 2023).

Due to the changed and gradually warming climate, these negative effects on wildlife are intensifying. This particularly affects the wildlife in built-up areas as well as the humans living there. Several studies have shown that in cities or neighborhoods with a lot of green space, people are happier and there are fewer individuals with mental health issues (Liu et al., 2023; Zhang et al., 2024). The likelihood of modern age diseases such as migraines, depression, and panic disorder developing is also lower than elsewhere. One reason for this may be that people are fundamentally connected to the natural environment, so a plant-covered environment has a calming effect, and stress factors do not manifest as strongly. The economic significance of this can be seen in the fact that the mental well-being of people (employees) leads to more efficient work. This, in turn, can positively influence GDP in the long run (Kisvarga and Orlóci, 2025). In addition, financial benefits also include the reduced healthcare costs that can result from the absence of mental illnesses. Therefore, the presence of green spaces is of paramount importance to human quality of life.

Urban green surfaces do not only provide direct ecological benefits but also fulfill numerous functions related to human factors. According to Statuto et al. (2021), these may include the following functions:

- ecological-environmental function;
- protective function;
- aesthetic-architectural function;
- social and recreational function;
- cultural and educational function;
- health and hygienic function.

Areas covered with plants may have the following primarily ecological functions according to Finke (1996):

- climate protection;
- protection against solar radiation;
- air purification;
- soil protection;
- protection of scientific and cultural values;
- protection of biotopes and ecosystems;
- landscape protection;
- provision of leisure and recreation.

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According to the above, urban green surfaces/areas possess numerous human-related functions. These include, according to Gábor and Jombach (2008):

- social functions (physical and mental recreation, nature-oriented agora);
- economic functions (increase in property values, enhancement of economic attractiveness);
- aesthetic functions.

Above all, however, the ecological (natural habitats, green corridors) and environmental protection functions of green surfaces and areas, such as noise and vibration reduction, dust filtration, water retention, are the most widely recognized human-related functions. Meanwhile, out of environmental functions, which influence environmental quality in urban environments, the air-conditioning and microclimatic effects of green surfaces/areas are the most important ones (Gábor and Jombach, 2008).

From the perspective of urban life, the greatest short-term health risk is caused by excessive warming. This is exacerbated by the increasing appearance of unplanted, paved heat islands over larger areas. This is the so-called urban heat island effect, which essentially means what we experience day by day in less vegetated urban environments. The decreasing vegetation cannot counteract the summer heat, while the human-made environment is unable to absorb the thermal energy of solar radiation; rather, it amplifies it. Thus, it can increase the temperature of paved public spaces by as much as 30–40 °C – creating a kind of heat island (Kisvarga and Orlóci, 2025). The costs of climate change will also largely be borne by cities – especially densely populated metropolises: increased temperatures and extreme weather events in cities will have alarming consequences for the urban population. Increased mortality may also be expected. For example, the increasingly frequent European heatwaves cause tens of thousands of deaths. The health of marginalized or elderly people, in particular, will be primarily affected by urban heatwaves and urban heat islands (Mocca et al., 2020).

In addition to evapotranspiration, trees cool the surrounding environment by shading the surface. Tree branches and leaves prevent incoming solar radiation from reaching the ground surfaces below the canopy. Typically, trees effectively block 70-90% of solar radiation in the summer and 20-90% in the winter. The location of the tree affects its effectiveness in cooling buildings, as trees on the west or southwest side of the building block most of the solar radiation from the building (Texas Trees Foundation, 2017).

A significant relationship has been found between human health status and the extent of green areas near places of residence. This relationship can be explained by the fact that the greater the proportion of usable green areas, the more people use them. Green areas have beneficial effects on alleviating mental fatigue, promoting physical activity, and may also reduce mortality rates. Furthermore, green areas have a stress-reducing effect (Schipperijn et al., 2010).

The relationship between human health status and green surfaces can be traced in (Western) European policy measures. In several national and local policy areas, such as urban development plans, the positive effects of green area use are mentioned. Some of these policy measures have made it clear that increasing green areas and improving their condition are of outstanding importance for human healthcare (Schipperijn, 2010). This is supported by Perényi (1975), who mentions both the health-protective and social functions of green areas (Table 1). Health-protective roles include, for example, the balancing of climatic conditions, filtration of dust and other air pollutants, noise reduction and dampening effects, and hindering the spread of fire. Social functions include making daily work, leisure, and living conditions more balanced and pleasant in an appropriate green environment.

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Table 1. Importance of urban green spaces (own editing, based on Perényi, 1975)

Healthcare	Recreation	Settlement climate	Environmental protection	Nature conservation
treatment of respiratory diseases (e.g. cave therapy)	hiking	protection against wind	CO_2 sequestration	preservation of biodiversity
psychological effects	excursions / trips	protection against solar radiation	noise barrier function	preservation of geodiversity
–	active/passive recreation	evapotranspiration of vegetation	hydrological protective function, water retention	ensuring ecological corridors
–	wildlife and plant observation	reduction of temperature anomalies	landscape protection	

The role of urban green areas in urban climate, including protected areas, is also emphasized by Radó (1985). According to him, the foliage mass of trees acts as a filter, enabling them to capture about 70% of the generated dust. One hectare of dense tree planting can capture approximately 30–60 tons of dust during the vegetation period.

Owing to the versatile benefits of green areas, by 2025, an increasing number of "green developments" aimed at sustainability have been launched in European cities, especially in EU capitals, with the clear goal of improving the quality of life for residents and making the settlements more livable. The next section shows a selection of these developments.

4. Best practices

To counterbalance the negative effects of urbanization, and in order to protect biodiversity and preserve green surfaces, several European cities maintain green belts and integrate extensive natural areas into their spatial structure. European cities with large green areas include Vienna, Ljubljana or Copenhagen, extensive green areas are almost embedded in the city center (Figure 2.). Furthermore, the city of Helsinki has developed an extensively used, integrated green surface network. Meanwhile in Stockholm, there are approximately 100 parks and 7 large protected areas, which together cover about 40% of the city area (Mason, 2003).

Table 2. Top 10 Greenest Cities in Europe in 2025 (Essential Living, 2025)

Rank	City, Country	Description
1	Oslo, Norway	Exceptional green space, high life expectancy, top air quality
2	Stockholm, Sweden	Strong sustainability measures and public transport
3	Vienna, Austria	Excellent urban green coverage and quality of life
4	Ljubljana, Slovenia	Increasing green infrastructure and livability
5	Copenhagen, Denmark	Progressive eco-initiatives and bike-friendliness
6	Lisbon, Portugal	Balanced green index and relaxed lifestyle
7	Tallinn, Estonia	Clean air, growing green spaces
8	Vilnius, Lithuania	Strong environmental strategy and green space access
9	Amsterdam, Netherlands	Vast canals, parks, and cycling infrastructure
10	Paris, France	High-quality urban green amenities despite dense population

The preservation of green, vegetation-covered areas – regardless of their classification – is a fundamental principle of sustainable urban living. Therefore, protecting and increasing urban green surfaces represents a serious task for both city leadership and local communities (Lányi, 2000). Nature conservation also supports this task, as it can counteract the negative processes and phenomena of urbanization (Goudie and Viles, 1997).

Today, an important development trend can be observed in (Western) European cities, whereby ecological networks are being created or existing ones are being developed in urbanized areas. This is particularly evident in Dutch cities, where central and local governments jointly make efforts to develop and protect existing and future ecological networks (Mason, 2003). A similar development direction was articulated by Perényi (1975), according to whom the green surface system has a prominent role in shaping urban structure, as vegetation-covered areas have multifunctional roles depending on their size and quality. Furthermore, when designing urban green surface systems, efforts should be made to ensure that green areas form a coherent whole and are not fragmented or isolated from one another. Therefore, urban green surfaces should not only

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be connected to each other but also to the large green areas surrounding the city, thereby ensuring, among other things, urban air circulation.

These urban-level ecological networks include some linear structures, such as watercourses and rows of trees which provide connections between parks and other public spaces and community areas. The ultimate goal of developing these ecological networks is to create a common, Europe-wide network.

Green cities strive to ensure that their urban development plans are aligned with urban climatological requirements. In some German cities, such as Freiburg or Stuttgart, building restrictions have been introduced in urban ventilation zones. Recognizing the importance of green areas in urban climate, the forests within the administrative area of Oslo, for example, are treated as protected areas (Mason, 2003).

In 2025, there are many international practical examples of how to make it a city green. Some of these developments could be transferred to Hungary as well.

- Copenhagen, Denmark: A leader in cycling infrastructure with extensive super cycle highways (The Climate Reality Project, n. d.).
- Stockholm, Sweden: The first European Green Capital (2010), known for sustainable planning, efficient public transport (The Climate Reality Project, n. d.).
- Ljubljana, Slovenia: Features extensive car-free zones in its center, abundant green space and its pedestrian-friendly city centre (Glasco, 2022).
- Milan, Italy: Known for "Bosco Verticale" (Vertical Forest) skyscrapers, integrating nature into buildings to boost biodiversity and reduce pollution. The project consists of two residential towers of 110 and 76 meters in height, located in the center of Milan, in the Porta Nuova district, hosting 800 trees, 4,500 shrubs, and 20,000 plants from a hundred different plant species (Stefano Boeri Architetti, n. d.).
- Vienna, Austria: Ecologically sensitive and health-oriented urban development and green spaces (Mocca et al., 2020).
- Vilnius, Lithuania (2025 Green Capital): Planting of over 68,000 trees and shrubs. Due to the intensive expansion of urban green spaces, over 94% of local residents now live within 300 meters of a park or natural area (Eurocities, 2025).
- Villach, Austria: Planting forest by Miyawaki method (Nastran et al., 2025) (Figure 2).
- Budapest, Hungary: Development of large parks, forests, and nature conservation (Budapest Főváros Főpolgármesteri Hivatal, n. d.).

In addition to planting tree rows, a new initiative, the planting of so-called micro-forests, is also underway. A micro-forest is an area of dense plantings, typically between 100 m^2 and 3000 m^2, which mimics a natural forest. It includes many native plant species and fits well into the urban environment. For example, since 2016, the Urban Forests association has planted more than 130 micro-forests in Belgium and France using the Miyawaki method (Urban Forests, n. d.). The Miyawaki Forest (MF), also known as a mini-forest or pocket forest, originated from a rapid reforestation method developed by Japanese botanist Akira Miyawaki in the 1970s, which has gained worldwide attention. This method represents a paradigm shift in ecological restoration, as the Miyawaki method offers a fast and effective approach to creating native forests in degraded or urban environments (Webber, n. d.). The MF concept emphasizes native species, dense planting, and soil preparation, promoting rapid forest development and increased biodiversity (Nastran et al., 2025).

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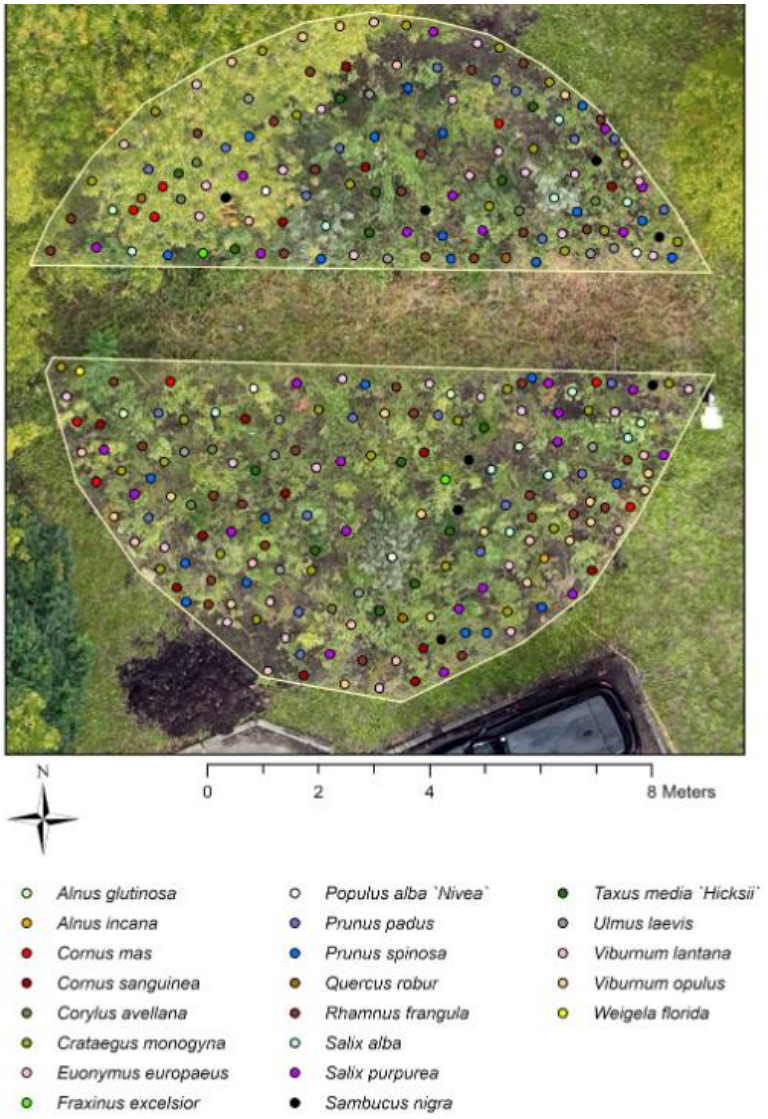

Figure 2. Visualization of the Miyawaki Forest planting from above in the Carinthia University of Applied Sciences in Villach *(Nastran et al., 2025, Figure 4)*

5. Conclusion

Urban green spaces play an important role in urban development, so their role needs to be re-evaluated during the urban planning process. This requires the will of local decision-makers, so local governments must take a leading role in these processes. Unfortunately, nowadays sustainability developments are often pushed into the background because social, infrastructural, and economic measures have priority. Additionally, economic actors are mainly interested in the development of urban infrastructure and other investments. This not only hinders the implementation of green concepts but also the exploration of potential research directions, as these are contrary to economic interests.

Despite all this, significant sustainability-oriented developments have been realized in several major European cities, including Budapest, in recent years. The expansion of green areas, the development of existing ones, and afforestation have improved the quality of life for urban residents. These developments are also necessary due to the increasingly intense warming, because the negative effects of climate change are more pronounced in the urban environment, for example, due to the heat island effect.

All in all, urban green spaces significantly contribute to the quality of life, well-being, and health of the population in everyday life. Therefore, green space developments should be considered a long-term investment, not a short-term cost.

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