Evaluation of urban green area development in the context of sustainable eco-city perspective: Bilecik (city center) case study

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Abstract

To provide good environmental quality standards in cities, the planned arrangement and strategic management of urban green areas are key. The arrangements to be made should be determined on a neighborhood basis and designed to meet the needs of the increasing population. Bilecik city has a settlement that develops outside of its historical core. The city's population, which shows linear development due to its topographic structure, is increasing in parallel with the developments in the education and service sectors. The city's constantly migratory structure has started to change with the increase in education opportunities and the development of the service sector due to receiving migration. The main comfort facilities that make the city livable are the social areas. The main purpose of this article is to present some useful techniques and strategies to improve the ecological sustainability of the urban structure that meets the basic principles of protection by considering social and economic feasibility. In this context, it is extremely important to plan the development of Bilecik city in a sustainable, accessible, and environmentally friendly way until 2030, especially in line with the Paris Climate Agreement. In the study, the suitability of the existing solutions regarding the urban green areas of Bilecik city was analyzed. The diversity, potential, and use of plants in the social areas that constitute the open-green areas of Bilecik city were examined in terms of urban landscape and evaluated in line with the Sustainable Development Goals. A proposal was presented on how Bilecik city can be developed towards becoming an eco-city. The problems that need to be addressed to develop sustainable, accessible, and well-connected cities of the future were evaluated.

Keywords: green area, eco-city, sustainable development.

Avaliação do desenvolvimento de áreas verdes urbanas no contexto da perspectiva de uma eco-cidade sustentável: estudo de caso de Bilecik (centro da cidade)

Resumo

Para proporcionar bons padrões de qualidade ambiental nas cidades, o arranjo planejado e a gestão estratégica das áreas verdes urbanas são fundamentais. Os arranjos a serem feitos devem ser determinados com base nos bairros e projetados para atender às necessidades da crescente população. A cidade de Bilecik possui um assentamento que se desenvolve fora de seu núcleo histórico. A população da cidade, que apresenta desenvolvimento linear devido à sua estrutura topográfica, está aumentando paralelamente ao desenvolvimento dos setores de educação e serviços. A estrutura migratória constante da cidade começou a mudar com o aumento das oportunidades de educação e o desenvolvimento do setor de serviços, recebendo a migração. As principais instalações de conforto que tornam a cidade habitável são as áreas sociais. O principal objetivo deste artigo é apresentar algumas técnicas e estratégias úteis para melhorar a sustentabilidade ecológica da estrutura urbana que atenda aos princípios básicos de proteção, levando em consideração a viabilidade social e econômica. Nesse

contexto, é extremamente importante planejar o desenvolvimento da cidade de Bilecik de forma sustentável, acessível e ecologicamente correta até 2030, especialmente em conformidade com o Acordo Climático de Paris. No estudo, foi analisada a adequação das soluções existentes para as áreas verdes urbanas de Bilecik. A diversidade, o potencial e o uso de plantas nas áreas sociais que constituem as áreas verdes abertas da cidade de Bilecik foram examinados em termos de paisagem urbana e avaliados em consonância com os objetivos de desenvolvimento sustentável. Foi apresentada uma proposta sobre como a cidade de Bilecik pode ser desenvolvida para se tornar uma ecocidade. Foram avaliados os problemas que precisam ser enfrentados para o desenvolvimento de cidades sustentáveis, acessíveis e bem conectadas do futuro.

Palavras-chave: área verde, eco-cidade, desenvolvimento sustentável.

1. Introduction

Cities are a complex system where economic, social, cultural, institutional, and natural structures and a wide range of risks are intertwined. As of November 2022, 56% of the world's population, which reached 8 billion, lives in cities, and the population living in cities is increasing (UN-Habitat, 2022). Cities, which host most of the population and industry, are responsible for 75% of natural resource consumption, 60-80% of energy consumption, and therefore at least 70% of greenhouse gas emissions (Irena, 2021a).

The creation and development of green areas in cities is a tradition that originates from ancient times. Today, eco-city practices change with societies, economy, politics, and different landscape styles. Land use has different distributions and components. In today's cities, restrictions that will reduce the amount and quality of suitable vegetation are encountered from time to time.

In the literature, new strategies are being proposed for both existing and newly established green areas through research areas such as green space, urban green space, sustainable cities, urban geography, and urban planning (Jim, 2004). Green areas are indispensable components of the urban fabric. In addition to the visual and aesthetic beauty they create, they have positive effects in many ways, from the climatic characteristics of the region to reducing the effects of air pollution in the region. They are also places where people living in the city use for recreational purposes and relieve stress in their free time. Such areas are gaining more importance in cities such as Bilecik, where development space is limited.

2. Sustainable urbanization and green areas

Along with increasing production, the disproportionate consumption of natural resources and the resulting increase in the emission of greenhouse gases that cause global warming have increased the interest in environmental problems in the world, and the studies carried out on this subject to increasing day by day. Rapid and unplanned urbanization, excessive population growth, and environmental pollution that emerged with the industrial revolution have begun to threaten the existence of green areas in cities (Yürük, 2022).

In addition, the rapid increase in the urban population all over the world has significantly increased the need for goods and services for consumption. This issue was emphasized at the United Nations (UN) Environment and Development Conference held in Rio in 1992, and the final report emphasized that production and consumption habits should be changed to achieve sustainable development. Again, at the World Summit on Sustainable Development, sustainable production and consumption were accepted as a prerequisite for sustainable development (REC Turkey, 2009). Until the 1970s, people only tried to determine what the problems in the environment were. However, after the 1970s, it was understood that the environment was an issue that not only institutions but also every person should care about and protect (Akkoy; Alkara, 2023).

In 1972, the concept of sustainability was first mentioned in the report titled "Limits to Growth" prepared by the Club of Rome. In the report, the concept of sustainability was defined as the appropriate use of natural resources without endangering the lives of all living things in the ecosystem (KGK, 2023). Then, in 1987, the World Commission on Environment and Development (WCED) explained sustainability in its report titled "Our Common Future" as "meeting today's needs without compromising the ability of future generations to meet their needs" (Aksu, 2011).

The Rio Summit held in 1992 led to the signing of the Framework Convention on Climate Change, which defined the environmental, social, and economic conditions necessary to reduce the amount of greenhouse gases in the atmosphere. The convention entered into force in 1994. In 1997, the world's countries gathered for the Kyoto Protocol. It includes guidelines and rules regarding the extent to which industrialized countries supporting

the protocol should reduce their greenhouse gas emissions (carbon dioxide, methane, nitrogen oxides, chlorofluorocarbons, hydrofluorocarbons, and perfluorocarbons).

The protocol entered into force in 2005. The protocol requires the party countries to reduce their greenhouse gas emissions by an average of 5% below 1990 levels between 2008 and 2012. This value is insufficient to meet the climate change targets by 2100. (Sathaye et al., 2006). Among the UN 2030 Sustainable Development Goals, goal number 11 has been determined as "Sustainable City and Life". Under this heading, many sub-goals have been set to make cities and settlements inclusive, safe, and durable. Some of these goals are:

Ensuring everyone has access to adequate, safe, and affordable housing and basic services and improving slums, Ensuring universal access to safe, inclusive, green and open spaces for people and people with disabilities, Supporting positive economic, social, and environmental connections between urban, peri-urban, and rural areas (UNESCO, 2022).

Sustainable urbanization aims to protect the environmental, economic, and social balances of cities through the efficient use of natural resources (United Nations, 2015). In this context, the concept of green city aims to reduce carbon footprint and protect biodiversity by offering an urbanization approach that respects nature (Van der Ryn; Cowan, 2007).

As a result of studies carried out to make the ecological development of cities sustainable, concepts such as sustainable cities, eco-city, and green city have recently become widespread in literature. The common objectives of these concepts, which constitute the sustainability steps, are to provide economic and social development by using environmentally friendly technologies and improving environmental conditions (Öztekin; Çolak, 2022). The shortest way to complete the ecological development of cities is to achieve sustainability goals specific to the city. The concept of sustainability consists of economic, social, and environmental sustainability dimensions. The first of these dimensions refers to fair sharing, the second to participation, and the third to the protection of natural resources. Sustainability can only be established by realizing these three dimensions in parallel and at the same time (Haştemoğlu, 2006).
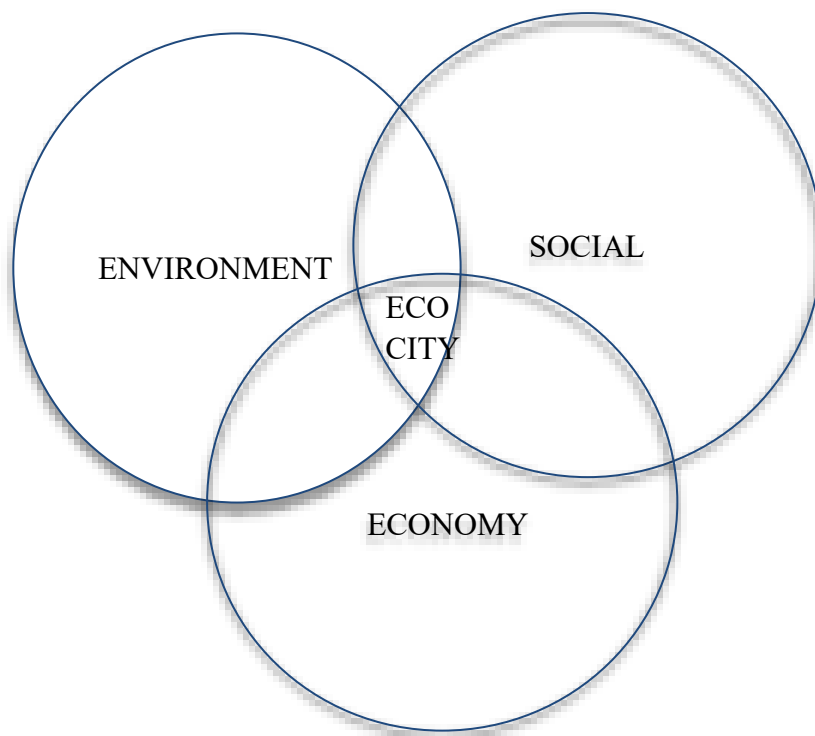

Figure 1. Dimensions of Sustainable Development. Source:(Akıncı; Pouya, 2019).

An ecological city is a concept that reduces environmental impact while increasing environmental quality. Eco cities are a concept that provides a life with low carbon emissions, waste reduction and recycling, increases the use of renewable energy-based resources, and supports environmentally dependent sustainable development goals (Lin, 2018).

In general, urban open green areas are grouped under seven different classes.

- Scattered Open Green Areas

- Green Belt System

- Public (General) Open Green Areas

- Semi-Private Open Green Areas

- Private Open Green Areas

- Urban Active Green Areas

- Passive Green Areas (Gül et al., 2021).

Green areas in cities (parks, green areas, walking areas, central median strips, side strips) are the most basic component of this process and are an important element of the use of local plant species and sustainable landscape. The environmental, social, and economic impacts of green areas are explained in (Table 1).

Table 1. Environmental, Social, and Economic Impacts of Green Areas.

Environment	Social	Economy
It reduces air pollution	It supports people's physical and mental health	Increase real estate values
Absorbs carbon dioxide and produces oxygen	Absorbs carbon dioxide and produces oxygen	It encourages tourism
It cools cities by reducing the heat island effect	It increases the quality of life	Provides infrastructure that is resilient to natural disasters
It supports biodiversity	Encourages international activity	Increased employment

Source: By Kuşat, 2013.

Sustainable urbanization is defined as growth achieved by using existing resources in cities in an efficient and environmentally sensitive manner. This concept aims to increase the quality of life of today's generations without endangering the needs of future generations. The principles of sustainable urbanization are as follows: Energy efficiency and renewable energy use, low carbon footprint, solid waste management and recycling, economic development at a level that meets the needs of society, social equality and inclusiveness (Akkaya, 2023).

When the concept of sustainable urbanization and green areas come together, a powerful tool is obtained to create environmentally friendly cities. In this context, sample applications carried out in the last decade can be listed as follows;

Smart Cities: Efficient management of green areas using technology,

Green Roofs and Vertical Farming: Solutions that reduce concrete and provide green areas,

Bicycle and Walking Paths: Provide environmentally friendly transportation alternatives by removing people from cars.

Community Participation: More meaningful and long-lasting results can be obtained by including the public in projects.

Sustainable urbanization and green areas are one of the most important components of modern cities. It contributes to making cities more livable in environmental, social, and economic terms (Abdullah; Selim, 2017).

2.1 Urban green areas and their characteristics

Since more than half of the world's population lives in urban areas, the sensitivity and vulnerability to climate change in cities are higher than in rural areas. Therefore, the management of green areas is very important to protect the urban ecosystem (Csete; Horváth, 2012). Green areas can help prevent flooding, reduce urban heat, improve air quality, and provide space for sustainable social activities. In sustainable and climate-friendly urban development, they have an increasing importance in terms of environmental services as well as economic, social, and environmental benefits (Westphal, 2003). In the process of combating climate change in the city, the

mitigation and adaptation activities of local governments (municipalities) are very important. In combating climate change, municipalities use self-governance, provisions, regulations, activation, and partnership elements in parallel (Bulkeley et al., 2009). The duties of the municipality include the organization and management of green areas, ensuring smart transportation, and energy efficiency. This includes:

Conceptually, open spaces are empty areas outside of structures and transportation axes (Eminoğlu et al., 2005). Green areas are defined as "surface areas of existing open spaces covered or arranged with plant elements (woody and herbaceous plants)" (Önder, 1997). In Turkey, the first urban planning plans between 1933 and 1956 regulated the green area per person as 4 m^2. This regulation was abolished with the Zoning Law in 1956, and the open-green area per person was envisaged to be 7 m^2 (Menteşe, 2019). According to the Zoning Regulation No. 3804, green areas are defined as "the total of playgrounds, children's gardens, resting, walking, picnic, entertainment, and coastal areas allocated for the benefit of society, metropolitan-scale fairs, botanical and zoological gardens, and regional parks".

Active green areas are the sum of urban and neighborhood parks, children's gardens, and playgrounds (Önder and Polat, 2012). Green areas in the city, which can be scattered and in the form of green belts, can be planned or spontaneously formed according to geographical conditions and architectural structures (Manavoğlu; Ortaçeşme, 2007). Societies gain physical and mental health thanks to green areas. Parks and gardens strengthen social ties by increasing interaction between individuals. When we look at the reductions provided by green areas, plants clean the air, reduce CO_2 levels, and reduce the demand for energy-intensive devices such as air conditioners, thanks to their cooling effect (Ministry of Internal Affairs of Hungary - VÁTI, 2011).

The protective effects of nature on the physical, psychological, and social health of society are expressed by various researchers (Takano et al., 2002). Trees, which constitute most of the urban green areas, are taken into consideration due to their important roles in filtering wind and noise, cleaning the air, and reducing pollution control costs. The aesthetic and relaxing values of trees increase the attractiveness of cities, encourage tourism, and ultimately provide economic benefits to cities by creating employment and income (Chiesura, 2004). From a physical and psychological perspective, natural scenes or elements stimulate positive feelings and reduce negative emotions, thus promoting stress relief (Rostami et al., 2014). Therefore, urban nature and daily outdoor recreation opportunities appear to be the main factors that increase the daily well-being of local people (Eronene et al., 1997). Urban open-green spaces can be grouped under three names: public, semi-private, and private areas according to their use (Önder, 1997).

Table 2. Usage areas of urban open green areas.

Public Open-Green Spaces	Semi-Private Open Green Spaces	Private Open Green Areas
City and neighborhood parks, urban forests and groves, cemeteries, botanical gardens, zoos, fair and exhibition areas, roads, boulevards and median strips, sports fields	Schools, military areas, public institutions and organizations, and factory gardens	Private property areas

Source: By Önder, 1997.

Biçen et al. (2019) talk about the economic, ecological, social, and physical functions and gains of green areas, and these issues are given in Table 3.

Table 3. Functions of green areas.

Economic Functions	Ecological Functions	Socials Functions	Physical Functions
Energy efficiency	Air Quality	Opportunity for educational and cultural activities	Roaming-access usage
Tourism opportunities	Filtering Unclean Air and Providing Clean Air	Reducing the crime rate	Area Protection
Tourism opportunities	Coolness and warmth effect	Opportunity for recreational activities	Use of Scale
Production Value	Effect on Relative Air Humidity	Contribution to social development	Aesthetic appearance
	Sequestering carbon in the atmosphere and reducing the greenhouse effect	Public health protection	A buffer role between the functional areas of urban uses
	Combating erosion and water balance		Historical preservation
	Ecological restoration/protection and fauna protection		Architectural influence
	Noise Pollution		

Source: By Biçen et al. 2019.

3. Materials and Method

3.1 Study area

The study area was determined as Bilecik (Center). Bilecik province is located in the southeast of the Marmara Region, at the intersection points of Marmara, Black Sea, Central Anatolia, and Aegean Regions. It is located between 39° and 40° 31' north latitudes and 29° 43' and 30° 41' east longitudes. Bilecik is adjacent to Bolu and Eskişehir in the east, Kütahya in the south, Bursa in the west, and Sakarya in the north. The surface area of the province is 4,321 km². According to the center-based census, the population of Bilecik in 2024 is 228,058. The population of Bilecik center is 82,416 (Tüik, 2025).

Autumn and winter months are rainy in the city, and summer is dry. The annual precipitation in the province varies between 450-500 mm, and the annual precipitation total is around 450 kg/m². In the province where snowfall is high, the number of rainy days is 38; the highest snow cover thickness is 44 cm. (Bilecik Nature Tourism Master Plan, 2013-2023). The annual average temperature value is 12.7 °C, the highest temperature in 2004 was 37.4 °C, and the lowest temperature was -12.5 °C. It is seen that 113 days are clear, 46 days are cloudy, and 207 days are cloudy in the province. The location of the Central District of Bilecik Province, which was selected as the study area, on the map is given in (Figure 2).

Figure 2. View of the Workplace Location. Source: Google Earth, 2025; City Guide, 2025.

2.2 *Method of the study*

In the study, the importance, function, and contribution of green areas to urban life were examined in line with the Sustainable Development Goals. In addition, the development of Bilecik (Center)'s existing active green areas, potential open green areas, and areas to be restored were evaluated. Data for the years 2022-2024 were obtained from the Bilecik Municipality Parks and Gardens Directorate and the Zoning Directorate. Bilecik Municipality Activity Reports and Performance Reports were examined, and data based on active, passive green areas, Bilecik (Center) park areas, and vegetation were compiled and compared with similar studies in the literature (Table 4).

Table 4. Change of active green areas per capita in Bilecik by years on a population basis.

Year	Green Area m²	Population
2022	13.46	84,243
2023	14.14	82,416
2024	14.46	82,403

Source: Authors, 2025.

As seen in Table 4, while the amount of green space per capita was 13.46 m² in 2022, this value increased to 14.14 m² in 2023 and 14.46 m² in 2024. However, the main reason for this increase is the decrease in the total population rather than the increase in green space production. The population, which was 84,243 in 2022, decreased to 82,416 in 2023 and 82,403 in 2024 (Tüik, 2024). Therefore, the increase in the amount of green space per capita should be considered as a relative gain. Despite this, the protection of existing green spaces and the planning and commissioning of new areas show that sustainable urban planning continues, and there is a positive will in this regard (Table 5).

Table 5. Change in Bilecik (Central) Green Area Amount over the Years (m^2).

Year	Green Area
2013	48,965.07
2014	11,577.90
2015	26,694.00
2016	17,354.00
2017	29,874.00
2018	17,164.00
2019	8,681.00
2020	8,811.00
2021	1,715.00
2022	9,445.00
2023	9,074.00

Source: Bilecik Municipality Activity Report, 2023.

When the annual change in green areas between 2013 and 2023 in Bilecik (Center) is examined, it is seen that the highest increases were obtained in 2022 and 2023, and the lowest increase was obtained in 2021. The change in plants planted in green areas over the years is given in Table 6.

Table 6. Bilecik (center) seedling, sapling, shrub, tree planting changes over the years.

Year	Number of plants
2013	5,267
2014	13,309
2015	6,540
2016	11,827
2017	82,661
2018	22,768
2019	140,308
2020	47,907
2021	99,567
2022	38,298
2023	63,842

Source: Bilecik Municipality Activity Report, 2023.

It has been determined that the seedling, sapling, shrub, and tree planting activities in Bilecik (Center) have increased significantly in the period 2013-2023, and the largest increase was achieved in 2019. The lowest increase was in 2011. It is seen that the number of seedlings, saplings, shrubs, and trees planted in 2023 was 63,842. One of the most important reasons for this is that the municipality has its greenhouse, and the plants are grown within the municipality. In this way, it can be implemented more easily without allocating significant financial resources. The change in seasonal flower planting, which ensures the aesthetic and visual development of the city over the years, is given in (Table 7).

Table 7. Changes in Seasonal Flower Planting in Bilecik (Center) According to Years

Year	Number of plants
2013	98,825
2014	99,000
2015	82,500
2016	117,880
2017	60,040
2018	99,170
2019	90,000
2020	55,000
2021	74,760
2022	52,320
2023	70,050

Source: Bilecik Municipality Activity Report, 2023.

It is thought that seasonal flower planting is done every year in the city center for aesthetic reasons, and the application amount varies between 50,000 roots and 120,000 roots, and the application amount is related to the budget.

In the study conducted by Eroğlu (2005) in Bilecik, it is stated that flower and fruit species are used in large amounts in terms of aesthetics in the plant species used in Bilecik province. However, it is stated that it would be more appropriate to landscape shrub species in certain groups because shrub-shaped plants will have sparse branches while growing, and it is sufficient to perform pruning and maintenance at certain periods. It is thought that the fact that seasonal flower data remained at values close to the average in 2023 is because pruning and maintenance works that should be done at certain periods were not done properly.

Bilecik is a transition region where the climate characteristics of the Marmara, Aegean, and Black Sea regions can be seen together. Summers are hot and dry, and winters are cold and rainy. Therefore, plants resistant to both drought and cold weather conditions should be preferred. The list of vegetation types suitable for Bilecik's climate is given in (Table 8).

Table 8. Plant species compatible with Bilecik.

	Scientific Name (Latin)	Area of Use	Water Need	Carbon Impact	Features
Trees	*Quercus* spp., *Pinus nigra*, *Cupressus sempervirens*, *Tilia* spp., *Lagerstroemia indica*, *Prunus cerasifera* 'Pissardii nigra', *Cercis siliquastrum*	Parks, Green areas and street afforestation	Middle	Positive	Shading, air quality improvement
Shrubs	*Lonicera nitida* (Honeysuckle), *Lavandula angustifolia* (Lavender), *Phormium tenax* (Formium), *Viburnum lucidum* (Shiny Snowball), *Abelia grandiflora* (Beauty Bush), *Pyracantha coccinea* (Fire Thorn), *Carex oshimensis* 'Evergold' (Carex), *Cornus alba* 'Sibirica' (Red-Stemmed Dogwood)	Parks, Green areas, Border planting, filling, and central median planting	Low-Medium	Positive	Visual variety, windbreak function
Seasonal Plants	*Viola tricolor* (Pansy), *Chrysanthemum* spp. (Chrysanthemum), *Vinca minor* (Persimmon), *Begonia* spp., *Anthemis* spp. (Daisy), *Papaver rhoeas* (Poppy), *Spartium junceum* (Brassberry)	Seasonal flower parterres	Middle	Positive	Aesthetic value, seasonal color variety
Ground Covers	*Thymus* spp. (Thyme), *Sedum* spp. (*Sedum* Species), *Mesembryanthemum roseum* (Persian Carpet)	Soil cover, central median planting	Very Low	Positive	Drought resistant, low maintenance

Source: Bilecik Municipality Parks and Gardens Directorate, 2025.

In the landscaping arrangements made in the city center of Bilecik, it has been observed that plant species with low maintenance requirements and high water efficiency are preferred. These preferences contribute to the ecological sustainability of the city. For example, species such as *Lavandula angustifolia* (Lavender) and Thymus spp. (*Thyme*). They are preferred due to their drought resistance and low water requirements, and also contribute to the reduction of carbon emissions.

Similarly, shrub species such as *Pyracantha coccinea* (Fire Thorn) and *Cornus alba* 'Sibirica' (Red-Stemmed Dogwood) play an important role in terms of both their aesthetic values and ecosystem services. The use of these species contributes to the increase of urban biodiversity and microclimate regulation.

These findings are consistent with the recommendations stated in the study by Zhang et al. (2024) that the needs of residents, ecological functions, and management strategies should be taken into account in the optimization of urban green areas. Additionally, the research by Chen et al. (2025) evaluated the carbon sequestration potential of different plant species, highlighting the importance of plant selection in landscape planning. The distribution of existing land use in Bilecik Province is given in (Table 9).

Table 9. Distribution of land assets in Bilecik based on use.

Land Asset Distribution	Area (ha)	Ratio (%)
Agricultural Area	125,081	29,04
Pasture Area	6,008	1,39
Forest Area	228,641	53,09
Area Unsuitable for Settlement and Agriculture	70,970	16,48
Total	430,700	100

Source: Authors, 2025.

3. Discussion

In a study conducted in Bilecik city center, it was determined that the amount of green space per person was 15.1 m² in 2017. However, it was determined that these green spaces were not distributed equally among neighborhoods and did not meet the needs in some regions (Menteşe, 2019). In addition, 114 plant taxa were identified in the plant inventory study conducted in open green spaces in Bilecik city center. This shows that the city has an important potential in terms of biodiversity (Kahveci, 2021). In a study conducted in Afyonkarahisar province, land use was analyzed according to elevation steps, and it was emphasized that topographic features should be taken into account in the planning of urban green spaces (Gültürk; Şişman, 2021). It was announced that 5 million square meters of green space was created in Afyonkarahisar Municipality in the last three and a half years (between 2018-2022), and the amount of green space per person increased by 57%. In addition, 89 thousand saplings were planted, 1.6 million flowers were planted, and 91 pocket parks were built (Afyon Municipality, 2022). In the Afyonkarahisar Provincial Disaster Risk Reduction Plan, it was stated that the presence of urban parks and green areas was increased and that these areas played an important role in reducing disaster risks (İrap, 2021).

A study conducted in Kütahya suggested the redesign of the city square and aimed to increase green areas and improve public areas within this scope. In addition, in an evaluation made on planning ideas in Kütahya, it was emphasized that urban social infrastructures, especially green areas, are important in increasing the quality of urban life (Atlas Academy, 2016).

A study conducted in Eskişehir province determined that the amount of green area per person was 13 m² in 2019 and concluded that Kentpark and Sazova Park had satisfactory values in terms of quality and quantity (Büyükbayraktar, 2019). In addition, green areas in the city center of Eskişehir were evaluated with the help of remote sensing and geographic information systems, and the effective use of technological tools in the planning of these areas was suggested (Uz, 2005).

These comparative evaluations show that Bilecik can benefit from the practices of other cities for the steps it will take towards becoming a sustainable eco-city. In particular, the studies of Afyonkarahisar and Eskişehir on increasing green areas and plant diversity can be an example for Bilecik.

Green areas in Bilecik need to be distributed more equally, especially in the city center and developing regions. This can be achieved, especially with the arrangements made in mass housing areas. Based on the experiences in Afyonkarahisar, it is important to consider topography and land use in local planning.

The use of geographic information systems (GIS), as in Eskişehir, can provide a more efficient management of green areas in Bilecik. In addition, the use of environmentally friendly technologies in the organization of open areas in the city is an important step for sustainable development.

By strengthening the relationship between social infrastructure and green areas, as in the example in Kütahya, more green areas can be created in the city squares and recreation areas in Bilecik. Such areas can increase the social interaction of city dwellers and improve the quality of life.

5. Conclusion

In this study conducted to evaluate the existence and quality of green areas in Bilecik (Center), it has been determined that the green areas in the center are not sufficient in terms of quantity and quality. In the study area, there will be 13.46 m² of open-green area per person in 2022, 14.14 m² in 2023, and 14.46 m² in 2024. This

value is higher than the 10 m^2 per person value that should be in zoning plans and the 12.63 m^2 of green area with trees per person determined by the "Carbon Neutral Cities on the Path to Green Development" project carried out by the General Directorate of Combating Desertification and Erosion of the Ministry of Environment, Urbanization and Climate Change. However, in addition to the quantity of open green areas, their balanced distribution is also important in terms of accessibility for the public using these areas. In addition, the quality that green areas carry / will carry during the implementation or arrangement of the usage areas given in quantity is also important. For this reason, the easy accessibility of green areas will contribute positively to the active use of urban residents and property value.

6. Recommendations

Other recommendations within the scope of the study are as follows;

- Projects that will increase green areas and rehabilitate existing areas, such as the National Garden, Bicycle Paths, green transportation projects, and restoration of historical areas, should be planned for Bilecik province.
- Considering the topographic conditions, recreational arrangements including viewing terraces, seating areas suitable for severe winter conditions, food and beverage units, parking lots, and children's playgrounds should be made for Bilecik.
- The necessary maintenance should be done on the open green area arrangements in the development areas of the city, and they should be made functional.
- Due to the construction in certain regions of Bilecik province, open green areas have been limited to a certain scale. For this reason, landscape studies should be carried out by considering the current and future status of certain plants.
- In order for there to be progress in terms of environmental sustainability in the city, decision-making bodies (governorship, municipality, and university) should examine the current situation and prepare a sustainability report that includes what can be done for the future.

7. Availability of data and materials

We would like to thank Bilecik Municipality for their assistance in providing samples and data during the research process.

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9. Authors' Contributions

Sevgi Akkoy: conceptualization, methodology, study design, and research. *Meryem Şahin:* validation, writing, methodology, investigation, writing, and scientific reading. submission and publication. *Edip Avşar:* coord**.**

10. Conflict of interest

The authors declare no conflict of interest.

11. Ethics Approval

Not applicable.

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