THE ROLE OF URBAN GREEN SPACES IN SUSTAINABLE URBAN PLANNING
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Abstract
Sustainable urban development is the phenomenon of battling environmental problems due to reasons such as increasing urbanization and gradual deterioration of the ecosystem. This phenomenon, which is developing around the world, is a subject open to discussion. This article highlights the importance of urban open and green spaces in the discussion of creating sustainable cities. In this context, the sustainable city criteria and the ecosystem services provided by urban open and green spaces were compared. In this context, seven different sustainable city criteria were evaluated: European Green Capital Award, European Green Flag Award, European Environment Agency Urban Metabolism Framework, European Foundation Urban Sustainability Indicators, Green City Index, Reference Framework for Sustainable Cities and STAR Community Assessment System. The findings confirm the importance of urban open and green spaces in terms of sustainable urban development.

Keywords: Sustainability, Urban Development, Green Spaces

1. INTRODUCTION
Although the concept of sustainable urban development seems like a new concept, its history is based on the Athens Treaty signed in 1933. With this agreement, the basic principles of sustainable urban development are defined [1]. Fifty-four years after this agreement, sustainable urban development was referred to in the report Our Common Future, prepared by the UN Commission on Environment and Development in 1987. In this report, problems such as "increase in urban poverty, increase in population, decrease in quality of life, increase in natural resource consumption"; and solutions to these problems such as "strengthening local governments, providing energy savings, protecting biodiversity and ecosystems, efficient use of natural resources" have been put forward [2]. The framework of sustainable urban development was developed with the Agenda 21 document, which was accepted at the Environment and Development Conference held in Rio de Janeiro by the United Nations in 1992. In the section of this document titled "Promoting the Development of Sustainable Human Settlements", attention is drawn

to improving human settlements' ecological, economic, and sociological quality. This section includes sustainable urban criteria such as adequate shelter for every citizen living in the city, improvement of local government, sustainable land use/management, establishment of integrated infrastructure systems, efficient use of energy, and sustainable transportation systems [3]. Thus, the goal of creating sustainable cities can be achieved by the participation of local government in sustainability, minimizing environmental pollution, using natural resources in a controlled manner, preventing horizontal spread in land use, reducing urban mobility, planning and designing livable areas [4]. In this sense, to create sustainable cities, the necessity of redefining and planning the functional identities and spatial qualities of land uses in cities emerges [5]. With the activities that define sustainable cities, such as redefining and planning land uses, the first concrete basis for planning urban green spaces, which have more than one role in the city, has been established [6]. Thus, urban green spaces stand out as role models in creating the basic components of sustainable cities and livable urban environments [7]. Achieving the goal of creating a sustainable city with this role model is related to the existence of urban green spaces.

2. METHODOLOGY
This study created conceptual frameworks by listing urban green spaces and sustainable city criteria with a literature review. As a material, sustainable city criteria, obtained as a result of literature studies, were examined. On the other hand, the urban green space management plan, which was also obtained from the literature studies, was evaluated as another research material.

In this context, seven different sustainable city criteria are:
• European Green Capital Award [9],
• European Green Leaf Award [1],
• European Environment Agency Urban Metabolism Framework [1],
• European Foundation Urban Sustainability Indicators [10],
• Green City Index [11],
• Reference Environment for Sustainable Cities [12],
• The STAR Community Assessment System [13] were reviewed.

To examine the relationship of those mentioned above sustainable urban criteria with urban green spaces as material:
• Urban Green Spaces were evaluated as study material.

The method of the study consists of examining urban green areas, the concept of a sustainable city and sustainable city criteria, collecting and evaluating literature data. Common sustainable city criteria were obtained from the sources obtained in the material section and analyzed with a holistic approach. The results obtained were evaluated with the urban green space planning criteria, and the connection and integration were revealed.

3. LITERATURE REVIEW
3.1. Sustainable City Criteria

Sustainable city criteria define the steps to ensure sustainable development in cities and encourage cities to be sustainable. Countries determine criteria on a national basis and criteria created by international institutions and organizations [19]. Sustainable city criteria, which constitute the methodology of this study, have been

prepared in tables. These criteria are as in Table 1, Table 2, Table 3, Table 4, Table 5, Table 6 and Table 7.

Table 1. Reference Framework for Sustainable Cities [19].

Categories/Indicators		Explanation
Spatial 1. Sustainable land uses 2. Regional resistance 3. Cultural heritage 4. Sustainable mobility 5. Quality public areas 6. Spatial equality **Social** 13. Social Equality 14. Accessible housing 15. Public areas 16. Inclusive education 17. Protecting health 18. Encouragement of recreational activities **Environment** 25. Water management 26. Sustainability of natural resources 27. Pollution reduction 28. Biodiversity 29. Climate change: Adaptation 30. Climate change: Mitigation	**Governance** 7. Integrated management 8. Sustainable economy 9. Evaluation and continuous management 10. Citizen participation 11. Strengthening management 12. Capacity building and networking **Economy** 19. Public participation 20. Sustainable production and consumption 21. Strong local government 22. Smart urbanization 23. Green growth 24. Eco-Innovation	It is a benchmark aiming at sustainability assessments in European cities. It is a web-based software developed under the leadership of the European Council of Municipalities and Regions, the French Ministry of Housing and Sustainable Houses and other organizations to achieve the goals of the Leipzig Charter and the vision of Sustainable European Cities adopted in 2007 and to support the integrated development of small, medium and large-scale cities in Europe [19]. This software developed is managed by the French Center for Risk, Environment, Mobility and Planning Expertise (CEREMA), and the framework is divided into 30 indicators in 5 main categories: spatial, management, sociological, economic and environmental [14]

Table 2. STAR Community Evaluation System [13].

Categories/Indicators		Explanation
• **Built Environment**	• **Climate Change**	It is a system created to determine the sustainability goals of local governments in the United States, measure their progress in sustainability, and improve their communities. The STAR evaluation system was created between 2008-2012 by evaluating local governments by an Executive Committee consisting of Technical Advisory Committees. The evaluation system was formed by eight technical advisory committees and 21 members of a technical advisory group. After this process, it was decided that any changes to the STAR evaluation system would be submitted to the technical advisory group for approval and sent to the executive committee for approval [13]. The STAR evaluation system is a framework that integrates the economic, ecological and sociological aspects of sustainability. In this context, the evaluation system consists of 49 indicators in 8 main categories
1. Ambient noise and light	8. Climate change adaptation	
2. Community water system	9. Greenhouse gas mitigation	
3. Compact communities	10. Energy efficiency	
4. Housing affordability	11. Water efficiency	
5. Land reclamation and improvement	12. Waste minimization	
6. Public open and green areas	13. Local government and Resources footprint	
7. Transportation choices	14. Green energy	
• **Economy and Jobs**	• **Education, Art and Culture**	
15. Business development	21. Arts and culture	
16. Greenmarket	22. Community cohesion	
17. Local economy	23. Educational opportunity	
18. Quality of work	24. Cultural heritage	
19. Industrial development	25. Social and cultural diversity	
20. Workforce readiness	26. Aging in the community	
• **Equality and Empowerment**	• **Health and Safety**	
27. Civic engagement	33. Active living	
28. Civil and Human rights	34. Community health	
29. Environmental justice	35. Emergency management	
30. Equitable services	36. Food and nutrition	
31. Human services	37. Health systems	
32. Poverty prevention	38. Hazard mitigation	
	39. Safe communities	
• **Natural Systems**	• **Innovation**	
40. Green infrastructure	46. Best practices	
41. Biodiversity	47. Exemplary performance	
42. Natural resource protection	48. Local innovation	
43. Air quality	49. Good governance	
44. Water in the environment		
45. Working lands		

Table 3. Green City Index [11].

Categories/Indicators		Explanation
• **CO$_2$** 1. CO$_2$ intensity 2. CO$_2$ emissions 3. CO$_2$ reduction strategy • **Waste and Land Use** 4. Local waste production 5. Waste recycling 6. Waste reduction policies 7. Green Areas Usage Policies • **Energy** 8. Energy Consumption 9. Energy Density 10. Renewable Energy Consumption 11. Clean Energy Policies • **Buildings** 12. Energy consumption in buildings 13. Energy efficiency in buildings 14. Energy savings in buildings	• **Environmental Governance** 15. Green action plan 16. Green management 17. Green policy • **Transport** 18. Bicycle and pedestrian network 19. Green transport 20. Traffic Reduction Policies 21. Use of non-car transport • **Air Quality** 22. NO$_2$ 23. SO$_2$ 24. O$_3$ 25. Particulate Matter 26. Clean Air Policies • **Water** 27. Water consumption 28. System leakages 29. Wastewater system treatment 30. Water efficiency	The Green City Index was developed in 2009 by the Economic Intelligence Unit (EUI) in partnership with Siemens. This metric, which enables the comparison of the sustainability performance of cities and the sharing of best practices with each other, covers more than 120 cities from Europe, South America, Asia, North America and Africa. This criterion, in which cities with high population and high labor force, which are the capitals of the countries, are selected, consists of 30 different indicators in 8 main categories. The eight main categories that make up the criteria are CO2 emission, energy, building, land use, transportation, water, waste management, air quality and management [11].

Table 4. European Green Capital Award [9].

Indicators	Explanation
1. Air Quality 2. Noise 3. Waste 4. Water 5. Nature and Biodiversity 6. Sustainable Land Use 7. Green Growth and Eco-Innovation 8. Climate Change: Mitigation 9. Climate Change: Adaptation 10. Sustainable Urban Mobility 11. Energy Performance 12. Governance	A city must have a population of at least 100,000 to apply for the Green Capital Award. However, in countries with no cities with a population of more than 100,000, the city with the highest population can use. According to the European Commission, a city is defined as "an urban area that includes metropolitan areas and is considered an administrative unit managed by a local government or another democratically elected body". In this type of assessment, attention is paid to local governments and community partnerships to achieve a high social and economic level in the city, together with the city's commitment to sustainability, enthusiasm, vision, and inspiration to other cities. There are 12 different evaluation criteria with these criteria [9].

Table 5. European Green Leaf Award [1].

Indicators	Explanation
1. Nature and Biodiversity 2. Sustainable Land Use 3. Air Quality and Noise 4. Waste and Circular Economy 5. Water 6. Climate Change and Energy Performance 7. Sustainable Urban Mobility	According to European Green Capital (2013), the Green Leaf Award is prepared for smaller cities according to the Green Capital Award. In this evaluation model, there is a difference in the number of the population and the categories. First, for a city to be evaluated, its population must be between 20,000 and 99,999. However, in countries with no city with a population of more than 20,000, the city with the highest population can apply. Cities that meet the requirements for the application are responsible for seven different criteria in this evaluation model [1].

Table 6. European Environment Agency Urban Metabolism Framework [1].

Indicators	Explanation
1. 1. Gross Domestic Product 2. CO_2 Emission 3. Registered Vehicles 4. Energy Use in Transportation 5. Public Transport Network 6. Land Use 7. Energy Consumption 8. Water Consumption 9. Waste Density 10. Recycling 11. Urban Area Amount 12. Accessible Green Areas 13. PM10 Concentration 14. NO_2 Concentration 15. Unemployment	According to the EEA (2018), it has been evaluated whether the performance of the metabolic flow of cities can be improved by creating a benchmark system based on the calculation of urban metabolism by the European Environment Agency (EEA). Fifteen criteria were determined within the set of criteria, and it aimed to measure urban metabolism in European cities with low costs. This approach can be used in cities of different scales. The main challenge during the evaluation system implementation is that it is necessary to have data in an appropriate format [1].

Table 7. European Foundation Urban Sustainability Indicators [10].

Indicators	Explanation
1. Global Climate 2. Air Quality 3. Acidification 4. Ecosystem Poisoning 5. Urban Mobility and Clean Transport 6. Waste Management 7. Energy Consumption 8. Water Consumption 9. Noise, Sound, Smell 10. Social Justice 11. Housing Quality 12. Urban Security 13. Economic Urban Sustainability 14. Green Spaces and Cultural Heritage 15. Community and Partnership 16. Unemployment	The European Foundation has proposed urban Sustainability Indicators as a tool to measure the sustainability performance of cities. The European Foundation has carried out studies on the indicators included in the European Charter of Sustainable Cities and Towns, which is accepted as the basis of the indicators and prepared in 1994. Thus, urban sustainability indicators were developed under the Pressure-Situation-Response (PSR) framework [10].

3.2. Urban Green Spaces

Cities are ecosystems containing natural structures and systems. For this reason, maintaining a healthy ecosystem in cities is possible with planning practices in which cities are handled with an ecosystem approach [14]. Sustainable urban development depends on the provision of a sustainable urban ecosystem by utilizing ecosystem services. Each of these ecosystem services can be measured and defined, have an important role in sustainable urban development. These ecosystem services are

provided by urban open and green spaces such as urban forests, urban parks and urban gardens [15]. Urban green spaces provide many different ecosystem services. In this sense, these areas cool the air with their vegetation and regulate the urban climate by reducing the urban heat island effect. They capture and store carbon released from numerous sources in cities. It also improves air quality by removing other air pollutants such as NO2, SO2, O3. Urban green spaces, which are rich in vegetation and natural surfaces, provide the continuity of biological diversity by meeting the needs such as nutrition and shelter for wildlife. Urban open and green spaces prevent precipitation waters from passing to the surface flow and reduce precipitation-induced erosion thanks to their permeable surfaces. Also, thanks to permeable surfaces allow the feeding of groundwater and surface water resources. Urban green spaces, with the presence of plants, contribute to the prevention or removal of various urban pollutants such as noise, sound and bad odor from multiple sources. Urban green spaces provide sociological and economic services in addition to ecological benefits. In this sense, it positively affects human physiology and psychology by providing recreational activities [16].

Urban green spaces covered with vegetal surfaces create a cooling effect, especially on hot days, and regulate the city's climate [17]. Link et al. (1940), in their study in Illinois, USA, measured 43 degrees Celsius on concrete-covered surfaces, 59 degrees Celsius on asphalt-covered surfaces, and 39 degrees Celsius in a city park covered with vegetation [18]. A similar study by Alparslan and Ortaçeşme (2019) revealed that urban open and green spaces are cooler than other areas in the city and that urban open and green spaces reduce the urban heat island effect by 3 degrees Celsius [19].

With their physiological characteristics, plants have the ability to store, filter or convert many pollutants into other forms [20]. According to the 8-month measurement results of Dochinger (1980), it was determined that deciduous trees reduce air pollutants in the atmosphere by 30% in rural areas and by 27% in urban areas. In a similar study, Scott et al. (1998), according to the results of their research in the Sacramento urban forest, determined that an urban forest annually holds 10.9 kg of air pollutants per hectare in the entire study area and 13.9 kilograms in urban area [21].

An important ecosystem service provided by urban green spaces is that these areas reduce or prevent urban noise [21]. In a study conducted by Perez Lopez and Lucas de Souza (2018) in the city of São Carlos, it was measured that urban green spaces can reduce urban noise levels by three dBA to 5 dBA [22].

Urban green spaces support biodiversity and contribute to its development with the plant species and diversity. In addition, urban green spaces can preserve their natural structures without being affected by urban pollution or being affected at a minimum level, thanks to their water resources, soil and natural structures. These features constitute important habitat areas for the protection and development of birds and insects living in cities and other living things and species part of wildlife [21].

Urban green spaces have economic benefits as well as ecological and sociological benefits for cities. To reveal the economic benefits of these areas, a study conducted in four different cities in Canada found that the houses located close to urban green spaces are 3% to 20% more valuable [23]. One economic benefit of urban green spaces is that the plant communities and urban trees in these areas reduce the energy used in cooling systems and provide energy savings, especially in the summer months, since they regulate the urban climate [24].

4. RESULTS AND DISCUSSION
4.1. Integrated Sustainable City Criteria

Sustainable city criteria are measurement and evaluation systems that promote sustainability in cities and aim to involve local governments and citizens in sustainability activities. The point that brings together the sustainable city criteria, which have similarities and differences, on a common denominator is achieving sustainable living in cities. Sustainable city criteria, integrated on a common denominator, can be gathered under a single roof, as seen in Table 10.

Table 10. Integrated Sustainable City Criteria [Orijinale]

Categories/Indicators	Explanation

• Climate Change (CC)
   ▪ Climate Change: Mitigation
   ▪ Climate Change: Adaptation
• Waste Management (WM)
• Air Quality (AQ)
• Basic Needs (BN)
• Green Transport (GT)
• Social Justice (SJ)
• Water Management (WR)
• Energy Efficiency (EE)
• Disturbing Elements (DE)
• Sustainable Land Uses (LU)
• Biodiversity (BI)
• Culture Heritage (CH)
	Seven different sustainable city criteria were used to create integrated sustainable city criteria. Categories and indicators in the table;
	• European Green Capital Award,
	• European Green Flag Award,
	• European Environment Agency Urban Metabolism Framework
	• European Foundation Urban Sustainability Indicators,
	• Green City Index,
	• Reference Environment for Sustainable Cities,
	• STAR Community Evaluation System
	was created with this in mind.

As a result of the examination and evaluation of sustainable city criteria, achieving sustainable urban development, in particular, seems to be significantly related to spatial planning, spatial designs and the spread of sustainable land use. In this sense, urban open and green spaces provide ecosystem services covering each criterion in the table.

4.2. Urban Green Spaces

From a city tree to an urban forest; There are urban green spaces of various types and characteristics, such as urban parks, children's playgrounds, hobby gardens, wetlands, nature parks. These areas differ according to their region, types and characteristics. However, the common point of these areas; supporting development with an ecosystem approach.

Urban green spaces support sustainable urban development thanks to the ecosystem services they provide and play a key role in the continuity of development. In this sense, the ecosystem services provided by urban green spaces have been compared with the sustainable city criteria. The results obtained are listed in Table 9.

Table 9. Services Provided by Urban Open and Green Areas [Original].

Categories/Indicators	Explanation
• **Climate Change (CC)** Climate Change: Mitigation ▪ Captures and stores carbon Climate Change: Adaptation ▪ Regulates the urban climate and reduces the urban heat island effect • **Waste Management (WM)** ▪ Waste recovery in artificial wetlands • **Air Quality (AQ)** ▪ PM10 concentration ▪ NO$_2$ concentration ▪ Other air pollutants • **Basic Needs (BN)** ▪ Permaculture provides nourishment with hobby gardens ▪ Supports physical and psychological health with recreational facilities • **Green Transport (GT)** ▪ Provides bicycle and pedestrian transportation • **Social Justice (SJ)** ▪ It provides social cohesion by bringing individuals together. • **Water Management (WR)** ▪ Feeding ground and surface water ▪ Stormwater management • **Energy Efficiency (EE)** ▪ Reduces the use of cooling systems that require energy with natural cooling • **Disturbing Elements (DE)** ▪ Blocks noise and sound • **Sustainable Land Uses (LU)** ▪ Areas of high spatial quality • **Biodiversity (BI)** ▪ Shelter and nutrition for wildlife ▪ Protection of species and habitats • **Culture Heritage (CH)** ▪ Preserves context and cultural heritage across urban green spaces and cultural heritage	Urban green spaces benefit the recovery of CO2 by supporting the carbon cycle, especially with the presence of the plants it contains. At the same time, it reduces the urban heat island effect by removing the carbon and various pollutants that cause urban heat islands and accumulate on urban surfaces and provides improvement and enhancement of air quality. Urban green spaces help in feeding underground and surface waters thanks to their permeable surfaces. Plants in urban green spaces prevent disturbing elements such as noise, sound, and bad odor, showing barrier properties. Plants create food production and shelter areas for wildlife. At the same time, thanks to these features, they ensure the protection of species and the increase and continuity of biodiversity. Urban green spaces are areas where city residents can do recreational activities and sports. Because of these features, it supports the psychological and physical health of individuals. At the same time, it brings individuals together and ensures the cohesion of society. Thus, it ensures that the consciousness of the society can be maintained. With these benefits provided by urban green spaces, they are effective areas in climate change mitigation and adaptation.

Urban green spaces are sustainable areas within the city that imitate nature and have natural systems. In this sense, when these areas with self-sustainability are considered within the scope of sustainable development; Although a city is not sustainable, urban green spaces in a city are sustainable areas. Urban green spaces are exemplary models for the creation of sustainable cities. Thus, the existence of urban green spaces constitutes an important criterion in sustainable cities.

4.3. The Relationship Between Sustainable Cities and Urban Green Spaces

Sustainable urban development aims to reverse the effects of deterioration in the ecosystem due to human activities through cities and raise urban living standards. Creating livable cities, which is desired to be achieved through sustainable urban development, will be possible by planning ecosystem services and ensuring the continuity of these services.

The primary goal of the sustainable city approach is to create a healthy urban ecosystem planned with an ecosystem approach. Improving public health by creating a livable environment with a healthy ecosystem is another important goal of sustainability. In this sense, providing healthy and livable environments and ensuring the participation of the public in sustainability will create positive effects in the implementation of the sustainable city approach. At the same time, a healthy ecosystem and community participation allows for the creation of a sustainable economy. Thus, the environmental, social and economic sustainability expected from sustainable cities will be achieved.
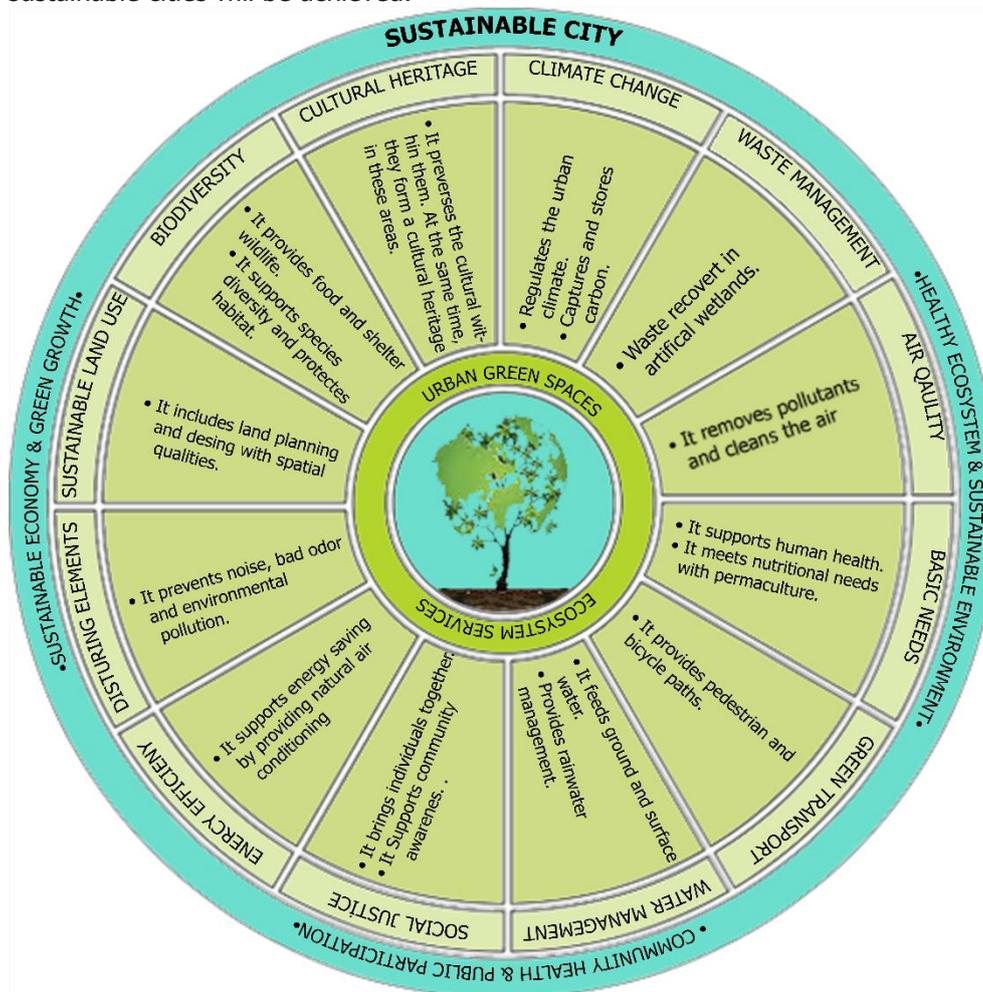

Figure 1 Sustainable Urban Criteria and Scope of Green Spaces [Original].

Many encouraging sustainable city criteria have been prepared for cities that aim to develop with the ecosystem approach. In this sense, sustainable city criteria define the ecosystem services offered by urban green spaces. The relationship between sustainable city criteria and urban green spaces is very important for the creation of a sustainable city. The relationship between sustainable cities and urban green spaces is as in Figure 1.

Urban green spaces and sustainable cities have a common ground in the sustainability goal. In a city, these two structures that make up the combination of sustainability are a combination set covering each other. Suppose urban green spaces and sustainable cities are considered separately from each other. In that case, it will cause sustainable urban development to be interrupted and the efforts made on sustainability to be insufficient.

5. CONCLUSION

To ensure sustainability in cities, an ecological balance should be established, and the ecosystem should be supported. Therefore, ecosystem services are needed to ensure sustainable urban development in cities where natural landscapes are transformed into built landscapes. In this context, urban green spaces provide ecosystem services, each of which can be measured and defined. To ensure sustainability in cities, an ecological balance should be established, and the ecosystem should be supported.

As a result, solutions with an ecosystem approach should be implemented to increase the quality of life in cities and ensure ecological, economic, and social sustainability. Urban green spaces offer effective solutions to ecological, economic and sociological problems encountered in cities. In this sense, it is possible to say that urban green spaces will be an important criterion in the discussion of creating a sustainable city. For this reason, urban green spaces should be considered as the centrer and pioneer of sustainability within the scope of sustainable urban development. From this point of view, both local and regional governments and professional disciplines specialized in sustainable urban development should ensure that the necessary responsibilities are fulfilled.

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