ISSN: 1648-6897 / eISSN: 1822-4199

VILNIUS TECH
Vilnius Gediminas Technical University

JOURNAL of ENVIRONMENTAL ENGINEERING & LANDSCAPE MANAGEMENT

2025
Volume 33
Issue 2
Pages 273–283
https://doi.org/10.3846/jeelm.2025.24184

DETERMINATION OF SUITABLE RECREATIONAL AREAS IN ADANA PROVINCE CUKUROVA DISTRICT BY AHP TECHNIQUE

Nurhan KOÇAN✉, Şeyma ŞENGÜR[2], Muhibe Aslı ALP[2], Ömer Lütfü ÇORBACI[3], Esra Çetinkaya ÖZKAN[4]

[1]*Faculty of Engineering, Architecture and Design, Department of Landscape Architecture, Bartin University, Bartin, Turkey*
[2]*Faculty of Agriculture, Department of Landscape Architecture, Ordu University, Ordu, Turkey*
[3]*Faculty of Engineering and Architecture, Department of Landscape Architecture, Recep Tayyip Erdogan University, Rize, Turkey*
[4]*Faculty of Architecture, Department of Landscape Architecture, Firat University, Elazig, Turkey*

Highlights:

- Urbanization and industrialization cause expansion into natural areas.
- Uses GIS-based spatial analysis to identify suitable recreational areas.
- It contributes to the management of urban sprawl by presenting a data-driven decision support model.
- Presents an ecological planning model for rapidly urbanizing regions.
- Implementing the suggestions to promote open green spaces and strengthen ecological connectivity will facilitate more sustainable and resilient urban growth.

Article History:

- received 04 September 2024
- accepted 09 April 2025

Abstract. Recreation is people's whole activity to regain their lost energy. In urban recreation areas, today's people can escape city life and reach themselves and nature at some point. In this context, the distribution, size, and accessibility of recreation areas in cities gain importance. The research aims to determine potential recreation areas by considering the natural and physical characteristics of the Adana Province Cukurova district.

The criteria and importance weights of the criteria related to the natural and physical characteristics of Cukurova district, which is the research area, were determined by Analytic Hierarchy Process (AHP) technique. The data layers of the criteria were overlapped using the "Weighted Linear Combination Technique" in ArcMap program using the importance weights and a map of potential recreation areas was created.

The results show that 2.6% of the region has low, 72.2% has medium, and 25.2% has high recreational potential. The western part of Seyhan Dam Lake has been identified as the most suitable area for recreation.

Providing a holistic green space system will enable the development of the city's natural potential. In addition, the areas proposed to be planned as recreational areas will contribute to urban ecosystem services and improve the quality of urban life. To define recreational suitable areas provides effective and quick solutions to manage urban sprawl on ecological. (Referee 1).

Keywords: urbanization, AHP, urban green spaces, recreational suitability, GIS.

✉Corresponding author. E-mail: ***nkocan@bartin.edu.tr***

1. Introduction

The historical development of open spaces dates back to ancient times. Many research works and historical descriptions provide evidence of the deliberate use of public open spaces in their settlements (e.g., Greek sacred gardens and agoras, the Roman forum, etc.) by ancient cultures (such as Egypt, Mesopotamia, then Greece and Rome) (Balogh & Takács, 2011).

Many definitions have been made of open space, and according to Gold (1980), "Open space is a general term that covers many classifications of land use". According to Yıldızcı (1982), open space is defined as "empty areas within or outside the city that are reserved for a specific land use purpose such as agricultural areas, forests, heaths, lakes, etc. or that respond to specific functions such as parks, gardens, squares, promenades, sports fields, playgrounds, etc."

It is possible to express the concept of open space generally as lands likely to have the same harmony with various land use types or land uses. In other words, there are natural landscapes such as countryside, rivers, bays, lakes, oceans, hills, mountains, canyons, reefs, deserts and their mixtures, and artificial landscapes such as water reservoirs, mining areas, agricultural areas, parks, plazas, flower gardens, golf courses, cemeteries, etc. Open spaces

are one of the most important essential components of the urban fabric, contributing to production such as agriculture, forestry, water, and energy within the city, being used as urban expansion areas, creating buffer zones or regions, serving as corridors for highways, railways, oil lines, hosting cultural heritage values, creating centers of attraction, being used for health purposes, and is used for active and passive recreational purposes such as walking paths, bicycle paths, and horseback riding.

Most urban open spaces are green areas, and open green areas refer to public and private open spaces covered with vegetation outside the structural regions of urban areas, made available to users directly or by planning for the needs of the society (Gurses, 1970; Keles, 1980; Swanwick et al., 2003; Gunal, 2010; Haq, 2011; World Health Organization [WHO], 2017; Lin, 2020). Urban green spaces are widely recognized as critical parts of the urban environment that support the livability and sustainability of cities (Wolff & Haase, 2019; Duku et al., 2023).

Urban green spaces offer numerous ecological and environmental benefits such as biodiversity conservation, habitat creation, stormwater runoff reduction, flood and erosion risk reduction, air quality improvement, microclimate and heat island effect, noise pollution reduction, and masking (Bolund & Hunhammar, 1999; Prance et al., 2014; Cilliers, 2015; Aronson et al., 2017; Osorio et al., 2022; Paudel & States, 2023). In addition to environmental benefits, there are also social benefits such as aesthetic value, stress reduction, improved quality of life, positive impact on physical and psychological health, social interaction, education, and recreation (Zhou & Rana, 2012; Cilliers, 2015; WHO, 2016; Vaznonienė & Vaznonis, 2017).

Despite all these contributions, urban green spaces in many cities worldwide are rapidly at risk of depletion, and among the driving forces of this trend, the rapidly growing urban population and the pressure created by urbanization are noteworthy (McDonald et al., 2010; Mensah, 2014). In addition to the threat of depletion resulting from the pressure created by urbanization and population growth, the development of technology and changing lifestyles have also further distanced humans from nature. Recreation encompasses all the activities through which humans regain lost energy, and urban recreational areas, namely urban open green spaces, are places where modern individuals can distance themselves from city life and ultimately connect with nature. In this context, planning urban open spaces from a recreational perspective and the distribution, size, and accessibility of urban recreational areas within cities become highly significant.

In this context, research methods for recreational planning are needed to accurately evaluate, analyze, and design natural, cultural, and visual values (Gul et al., 2006). Appropriateness techniques are essential for informed decision-making and enable planners and local decision-makers to analyze interactions in multiple ways (Steiner et al., 2000; Ozugul, 2012). The Analytical Hierarchy Process is a method approach widely used in the location selection of recreational areas due to the many requirements that should be taken into account in the process (Dağıstanlı et al., 2018; Caglayan et al., 2020; Toapanta Orbea et al., 2021; Lu et al., 2022; Srdjevic et al., 2022; Luo et al., 2022; Aşılıoğlu & Çay, 2023). In the process of mapping the relevant spatial parameters and creating the suitability map, Geographic Information Systems are accepted as a practical spatial analysis tool (Lindenbaum, 2006; Gacu et al., 2023).

The factors used in the suitability analysis are standardized and synthesized according to the weight values determined in line with the purpose of the study (Saha & Roy, 2021). This spatial analysis plays a vital role in determining the most suitable areas by analyzing the spatial data related to the area to be planned, taking into account environmental sustainability.

The research was carried out in the Cukurova district of Adana Province, where urbanization is intensified, and the need for recreational areas is increasing in parallel. The research aims to determine potential recreation areas by considering the natural and physical characteristics of the Adana Province Cukurova district. The literature review carried out for the research's purpose was considered. Slope (Gul et al., 2006; Chhetri & Arrowsmith, 2008; Sohrab et al., 2020), aspect (Krämer & Roth, 2002), erosion (Erdogan et al., 2013), proximity to the road (Gelan, 2021), proximity to natural landscape assets (Nordh et al., 2011; Derr et al., 2016), proximity to residential areas (Santos et al., 2016; Gelan, 2021), proximity to the dam (Gul et al., 2006; Gelan, 2021; Voigt et al., 2014; Wang et al., 2021) criteria were selected.

2. Material and method

2.1. The study area

The primary material of the study is Adana province Cukurova district. Adana province is located in the east of the Mediterranean Region between 36°32′ and 38°23′ north latitudes and 34°42′ and 36°42′ east longitudes. The study area is one of the 15 largest districts of the province and is the central district. The area is bordered by Seyhan Dam Lake in the north, Karaisalı District in the northwest, Seyhan District in the south, Sarıcam District in the east, Mersin Province in the west and has a plain nature (Figure 1). The study area is 31.387 ha, and the district population is 389.319, according to 2021 TURKSTAT data. 48.08% of the population is male and 51.92% is female. Looking at the population values of the last fourteen years, it is seen that the population has increased (Turkish Statistical Institute, 2021).

There are various techniques to evaluate the suitable location of parks and recreation areas in cities (Miyachi et al., 2003). The Analytical Hierarchy Process (AHP) is one of the most widely used techniques for appropriate site selection (Zhou & Troy, 2008).

Developed by Saaty (1980), AHP provides a flexible and easy-to-understand way of analyzing complex problems. It is a multi-criteria decision-making technique that

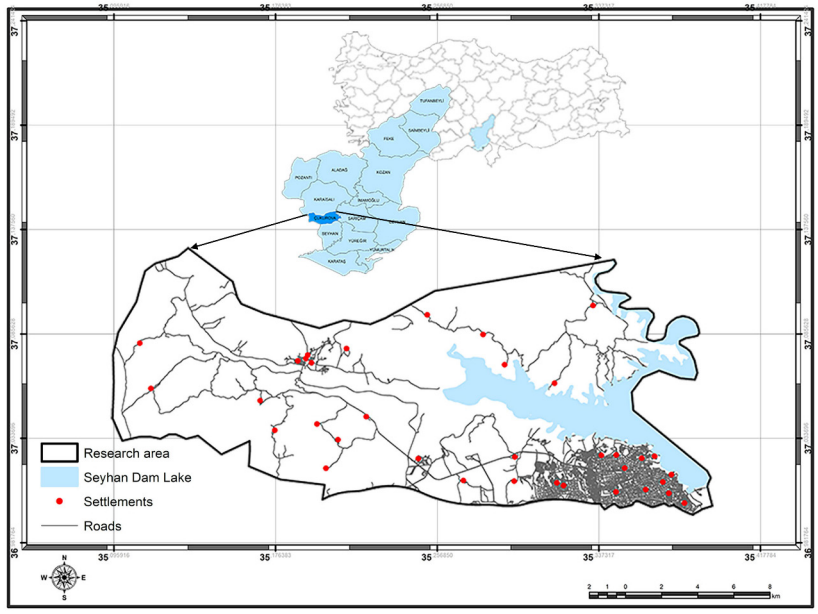

Figure 1. Location of the study area

is objective as well as subjective. AHP ensures the active participation of decision-makers. It has the quality of making rational decisions for the managers in reaching the final agreement. Therefore, qualitative or semi-quantitative methods are often helpful for regional studies (Soeters & Van Westen, 1996; Guzzetti et al., 1999; Lynch, 2021; Dong et al., 2021).

Within the scope of the research

- To determine the recreation areas of Cukurova district with its strategic location around Seyhan Dam Lake, critical agricultural areas, and cultural richness.
- It is aimed to evaluate the size and distribution of urban open spaces within the city.

2.2. Method

The research is based on determining suitable recreational areas with the Analytical Hierarchy Process approach. The Analytic Hierarchy Process (AHP) method is a multi-criteria decision-making approach developed by T. L. Saaty between 1971 and 1977 (Saaty, 1987). The AHP method uses a hierarchical model of purpose, criteria, sub-criteria, and options for each problem. Different importance levels of the variables are evaluated for the decision-making process (Ozcan et al., 2009). While solving the problem, the weights of the criteria that make up the hierarchy are calculated after the hierarchical structure is established (Ozturk & Batuk, 2010). The next step after the model is based is to determine the relative weights of the factors at the same hierarchy level, and it is carried out in the form of pairwise comparisons of the lower-level factors related to the higher-level factor (Canhasi, 2010). A scale of 1-9 is used for measurement (Saaty, 1987) (Table 1).

To compare the factors identified in the study and determine the weight of different influencing factors, the opinions of 3 experts who completed their doctorate in the Landscape Architecture Program were taken. The evaluation was carried out in the form of a survey.

The data obtained after the pairwise comparison of the criteria/variables are converted into a matrix to calculate the weights, and the overall weights are calculated by combining the weights of all experts (Canhasi, 2010) (Table 2).

In this approach, which is based on expert opinion, the consistency of the evaluations gains importance as the expert's ability, experience, and intuition come into play. In

Table 1. Basic scale used in AHP technique (Saaty, 1987)

Severity	Definition	Explanation
1	Equal importance	The two criteria/variables contribute equally to the goal
3	Moderate importance of one over the other	Experience and judgment strongly favor one criterion/variable over the other
5	Basic or strong importance	Experience and judgment strongly favor one criterion/variable over the other
7	Very strong importance	A criterion/variable is strongly favored and its dominance has been proven in practice
9	Extreme importance	Evidence favoring one criterion/variable over another has the highest possible level of validation
2, 4, 6, 8	Intermediate values between two adjacent jurisdictions	When compromise is needed

Table 2. AHP pairwise comparison matrix

Criterion/variable	Criterion/variable significance scale			Criterion/variable
	More Important	Equal	Less Important	
C/V 1	9 8 7 6 5 **4** 3 2	1	2 3 4 5 6 7 8 9	C/V 2
C/V 2	9 8 7 6 5 4 3 2	1	**2** 3 4 5 6 7 8 9	C/V 3
C/V 3	9 8 7 6 **5** 4 3 2	1	2 3 4 5 6 7 8 9	C/V 1

Criterion/variable	C/V 1	C/V 2	C/V 3
C/V 1	1	4	5
C/V 2	.....	1	1/2
C/V 3	.....	.....	1

this context, the problem's random index is calculated and expected to be below 0.1 (Canhasi, 2010).

AHP consists of 5 stages for the purposes and objectives of the study. "Determining the criteria and restrictive criteria" is the first step in the process. In this process, the studies were conducted to determine suitable recreational areas. Slope, aspect, erosion and natural landscape existence, cultural landscape existence (Seyhan Dam), and proximity to roads and settlement areas were determined as the criteria of the study (Ebrahimi et al., 2019; Caglayan et al., 2020; Turgut et al., 2021).

The other stages of the study are "preparing data layers for the criteria", "determining the fitness values of the criteria", "determining the criteria weights with the AHP technique", and "obtaining the map of recreationally suitable areas with the linear combination technique".

3. Result

Cukurova district center became the fastest-growing district in Adana after the zoning revisions in 1991–1992 (Adana Development Alliance Foundation, 1999). The adverse conditions that have emerged in urban environments with the increase in urbanization have increased the recreational needs of those living in cities. The district has natural landscape values with Seyhan Dam Lake in the north, Seyhan Dam Lake and Seyhan River in the east and agricultural and forest-maquis areas in the north and west. These natural areas create an essential potential for recreational uses. However, recreational activities in natural areas must comply with environmental conditions. In this context, in the study, slope, aspect, erosion and natural landscape existence, cultural landscape existence (Seyhan Dam), proximity to roads and settlement areas criteria were selected, and suitable recreation areas were determined.

In line with the criteria determined within the scope of the study, "slope", "view", "erosion", "proximity to natural landscape", "proximity to cultural landscape (Seyhan Dam Lake) existence", "proximity to the road" and "proximity to residential areas" maps were created. Slope and aspect maps were produced using the "ALOS PALSAR DEM dated

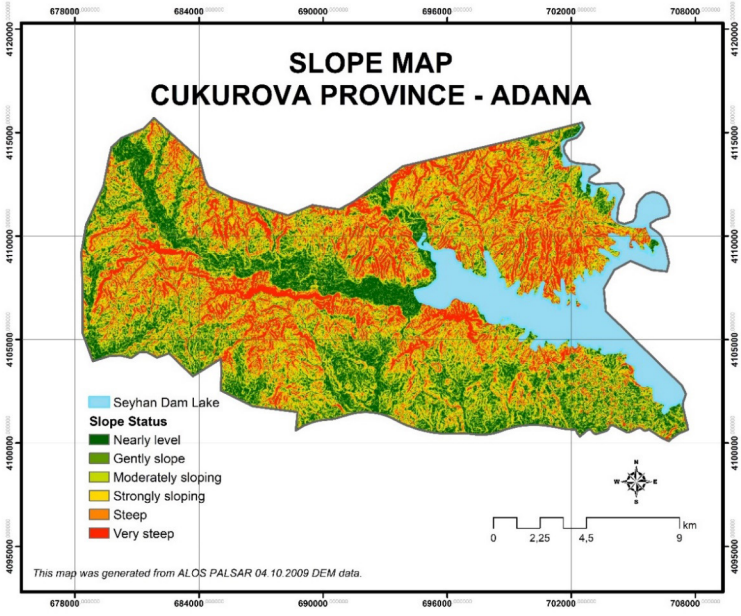

Figure 2. Slope map of Cukurova Province-Adana

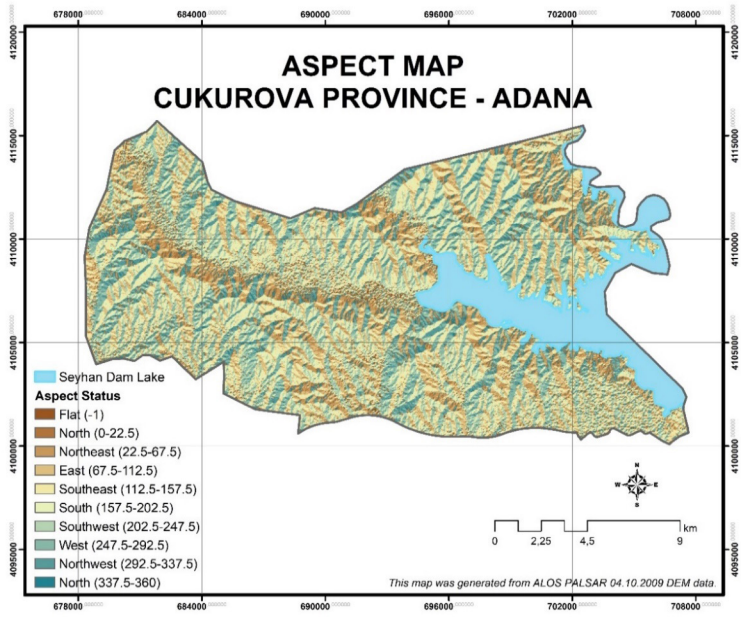

Figure 3. Aspect map of Cukurova Province-Adana

04.10.2009" area data in the ArcMap software from GIS. When the slope of the area is examined, it is seen that 4235 ha is almost flat, 5034 ha is slightly sloping, 5316 ha is medium sloping, 4590 ha is high sloping, 4625 ha is steep, and 4284 ha is very steep (Figure 2).

To examine the aspect of the area, a map including the north, northeast, east, southeast, south, southwest, west, and northwest directions was produced, and it is seen that the dominant aspects of the area are east, southeast, south, southwest and west (Figure 3).

Erosion is another criterion to determine recreationally suitable areas, and the T.C. Ministry of Agriculture and Forestry determines the erosion status of the area. It was produced from the numerical erosion data. According to the data, 2% of the area has a very low, 62% low, 32% moderate, and 4% very high erosion risk (Figure 4).

Finally, within the scope of the study purpose, the proximity criterion was evaluated in the ArcMap software, and the proximity analyses of the natural landscape assets, cultural landscape assets, roads, and settlements were carried out. The area expressed as a cultural landscape asset is the Seyhan Dam Lake, and this region has a significant recreational potential for the province of Adana (Figures 5, 6, 7, 8).

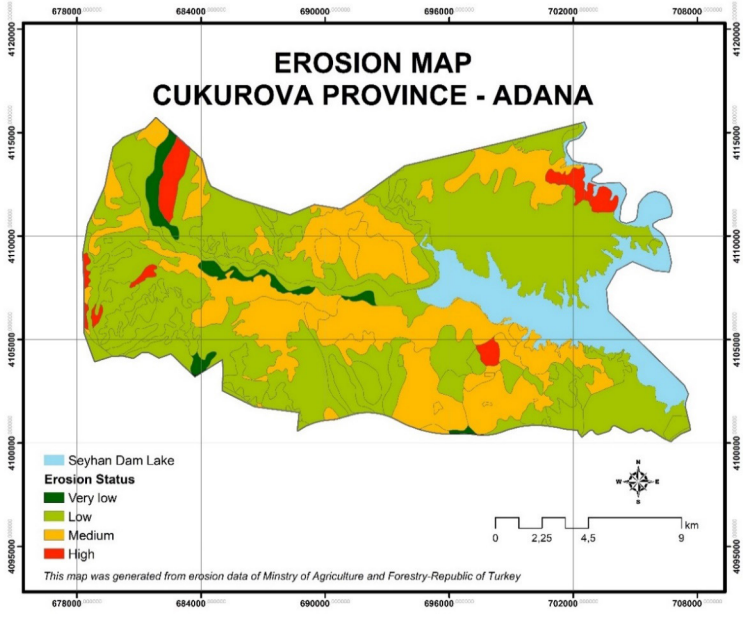

Figure 4. Erosion map of Cukurova Province-Adana

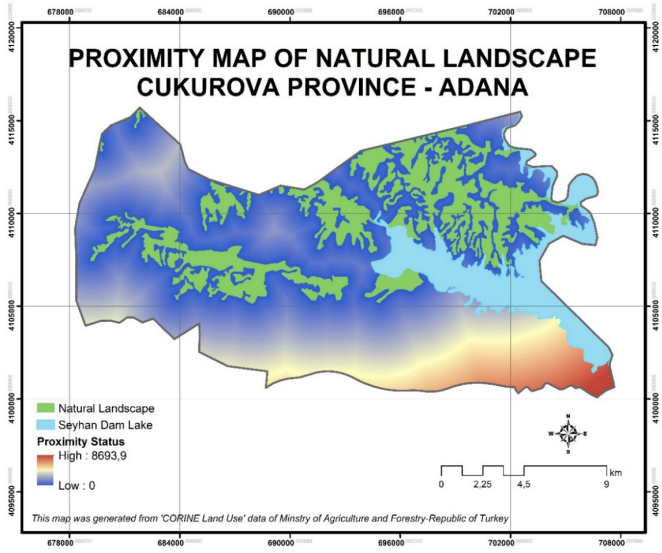

Figure 5. Proximity map of natural landscape, Cukurova Province-Adana

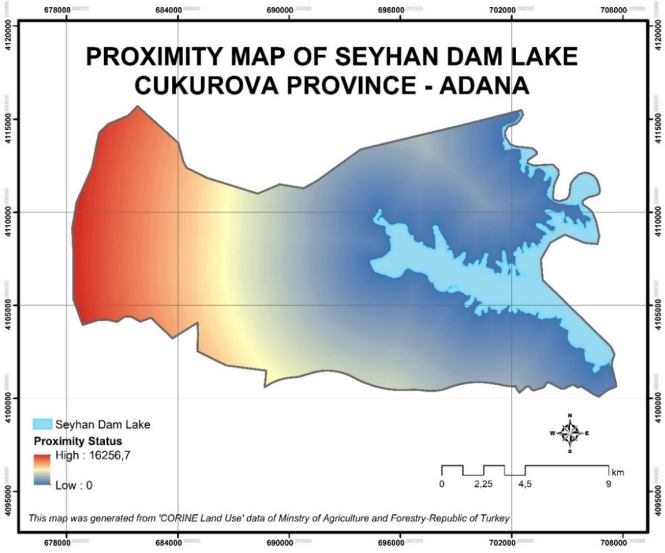

Figure 6. Proximity map of Seyhan Dam Lake, Cukurova Province-Adana

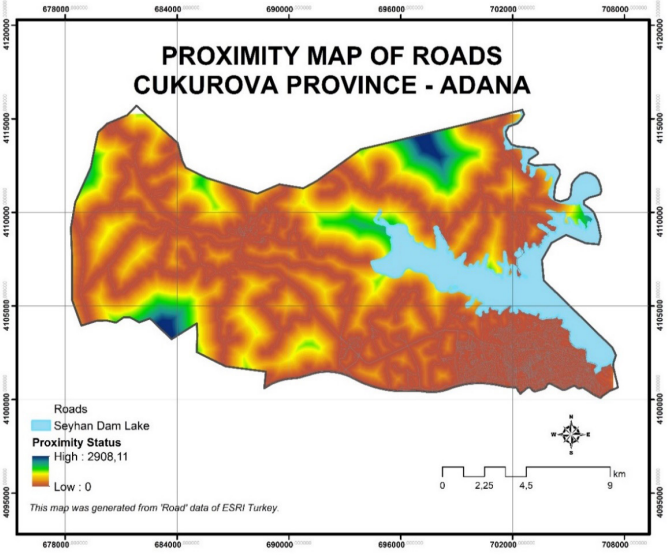

Figure 7. Proximity map of roads, Cukurova Province-Adana

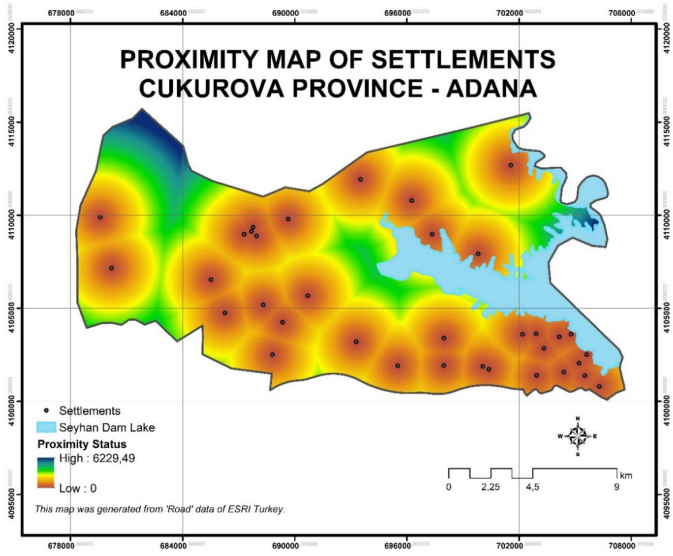

Figure 8. Proximity map of settlements, Cukurova Province-Adana

All produced data were reclassified as "high, medium, low, and very low" according to the level of importance to be included in the weighted linear combination. A relevant preference has been developed for slope, aspect, and erosion. On the slope map, "flat and nearly flat areas and slightly sloping areas" are classified as high, "medium sloping areas" as medium, "highly sloping areas" as low, and "steep areas and very steep areas" as very low. For the aspect map, in recreational terms, "south, east, southeast" was determined as high, "southwest, west" middle, "northeast, northwest, flat area" as low, and "north" directions were determined as very low. The erosion status is classified as "high areas" very low, "medium areas" low, "low areas" medium and "very low areas" high.

After determining the criteria and producing the data, the criteria' suitability and relative importance were evaluated by three experts who were not parties to the research to determine the weights. As a result of the evaluations made by experts who are landscape architects and have completed their doctorate education, weights were obtained, and matrix consistency ratios were calculated (Table 3). The same process as in the AHP method was applied in the calculations.

With the weights obtained, a "Recreationally Suitable Areas Map" was produced using the "Weighted Linear Combination" technique in the ArcMap program (Figure 9).

Multi-criteria decision analysis method; it allows the evaluation of many ecological, social, economic, and cultural criteria together and the analysis of complex environmental problems. With this method, multiple criteria can be analyzed together according to the determined priority order (Herath & Prato, 2006). This study used the weighted linear combination method to combine the criteria. The Recreation Areas Suitability Map was produced using the weights obtained during the AHP process for the defined parameters.

Recreation Areas Suitability Map = f {Slope, Proximity to residential areas, Proximity to the road, Aspect, Erosion, Proximity to the dam, Proximity to natural landscape presence}

$$RASM = \sum (ni = 1Slp1 \times Wti1 + ProxRes1 \times Wti2 + ProxRoad1 \times Wti3 + Aspct1 \times Wti4 + Ers1 \times Wt15 + ProxDam1 \times Wt16 + ProxNat1 \times Wt17),$$

where RASM – Recreational Areas Suitability Map; Slp – Slope; ProxRes – Proximity to residential areas; ProxRoad – Proximity to the road; Aspct – Aspect; Ers – Erosion; ProxDam – Proximity to the dam; ProxNat – Proximity to natural landscape presence; Wt – Weights.

When the result map is examined, 2.6% of the area was low, 72.2% was medium, and 25.2% was high suitability

Table 3. AHP pairwise comparison matrix for suitability of recreational areas

Experts	Consistency Rate	Slope	Proximity to Residential Areas	Proximity to the Road	Aspect	Erosion	Proximity to the Dam	Proximity to Natural Landscape Presence
E1	0.151	0.059	0.200	0.286	0.038	0.022	0.197	0.194
E2	0.181	0.053	0.156	0.159	0.125	0.042	0.161	0.303
E3	0.384	0.161	0.299	0.081	0.0831	0.074	0.181	0.117
Avg.	**0.007**	**0.082**	**0.244**	**0.167**	**0.064**	**0.045**	**0.201**	**0.197**

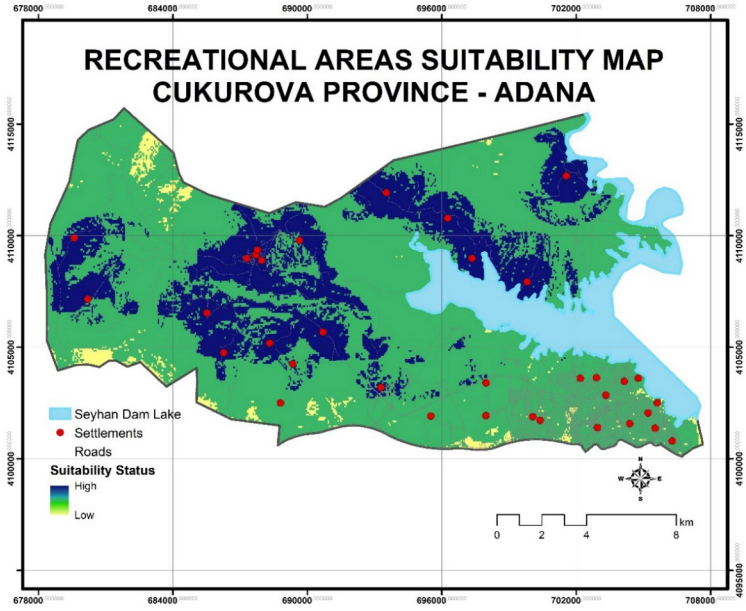

Figure 9. Recreational areas suitability map, Cukurova Province-Adana

areas. When the high suitability areas are concerned, it is seen that the natural landscape presence, erosion, and slope criteria are dominantly effective. Areas close to roads, settlements, and natural landscapes, which are low in erosion and slope, were determined as areas with high suitability. Moderately suitable areas are close to residential areas, roads, and dams and are relatively close to natural landscapes. The areas with low suitability are ideal for slope and erosion. Still, the areas identified in the southwest and northwest of the area are not considered suitable for recreational purposes since they are far from roads and settlement areas. Being away from the natural landscape is a dominant factor in the areas within the city, close to the road and settlement but with low availability. It is seen that the low suitability areas in the northeast do not have recreational potential due to their distance from the road, even if they are close to the natural landscape.

The fact that the designated recreation areas include different land uses such as waterfront, forest, and agricultural regions will respond to the versatile recreational activities of the district people. Having suitable recreation areas in other parts will meet the recreation needs of the increasing district population. It will also ensure the protection of these areas by preventing concentration in one region. One of the places deemed suitable for the recreation area is north of Seyhan Dam Lake. This area is located on the lake shore and has a close physical and ecological relationship with the lake. In addition to being an element that meets recreational needs, water is also a resource value with a sensitive ecological structure. Determining this area as suitable for recreation also reveals the need for correct planning of the lake shore. When planning for recreational use of water surfaces and coasts, the protection-use balance should be based on not damaging the water source and shore, and visitors should be allowed to use the area to get maximum benefit.

The western region of Seyhan Dam Lake is another area suitable for recreation. This region includes lands and forest areas with agricultural value. Forest areas should be integrated with existing recreation areas without changing quality and quantity. Sustainable forest management should ensure the planning of recreational activities in forest areas. Local governments and non-governmental organizations must set standards and rules on this issue.

Rural recreation type should be chosen for areas showing recreation potential that are intertwined with agricultural areas. Complementary uses such as holiday farms, camping, and picnic areas will suit these recreation areas (Çelik & Şenay, 2023).

4. Discussion

Today, the structural features of cities are not limited to meeting human housing needs; open green areas also play a vital role in increasing the quality of life and maintaining the ecological balance. Open green areas have a wide range of functions, such as supporting the biological diversity of cities, improving air quality, providing water management, and encouraging social interaction. However, unplanned growth, incorrect land use, and inadequate green area protection strategies have led to a decrease in these areas both quantitatively and qualitatively. In recent years, increasing sensitivity to the environment and scientific research have paved the way for essential steps to be taken towards protecting and developing these areas. In this context, the more effective inclusion of open green areas in urban planning is critical in ensuring the ecological balance.

Many studies emphasize that open green areas should be interconnected. These connections ensure the continuity of ecosystem services and support biodiversity. Wetlands, in particular, play an essential role in the ecological cycle; integrating these areas with the green texture is a crucial requirement for ecosystem health. Wetlands such as Seyhan Dam Lake offer ecological benefits and great potential for recreational use. These areas allow urban residents to spend time in nature, engage in physical activity, and increase environmental awareness. Therefore, integrating wetlands and other natural areas with green textures is of great importance in terms of both ecological and social benefits.

In regions with fertile agricultural lands and strategic geographical locations such as Çukurova, a holistic green area system must be established to develop the natural potential. Such a system supports agricultural and industrial activities and enables an environmentally sensitive urbanization process. Proper planning of green areas is one of the cornerstones of sustainable urbanization.

However, any recreational intervention made in natural areas can permanently affect the ecosystem. Therefore, ensuring the balance between protection and use in determining recreational regions is vital. In this context, multi-criteria decision analysis methods such as AHP (Analytical Hierarchy Process) can be used as an effective tool in selecting and placing recreational areas. AHP helps decision-makers determine the most appropriate options by allowing different criteria (e.g., environmental protection, social benefit, accessibility, etc.) to be weighted. This method provides a more objective and comprehensive approach to decision-making processes by ensuring expert opinions and stakeholder participation. The use of AHP in green space planning contributes to making nature-friendly decisions and ensures that recreational areas are compatible with urban life.

The most critical factor in the accuracy and effectiveness of the AHP process is the connection and diversity of the determined factors to the subject. Within the scope of the research, the parameters of slope, aspect, erosion, proximity to roads, proximity to residential areas, proximity to dams, and proximity to natural landscape assets were considered. The most critical constraint in diversifying the factors for the research area is experienced at the data acquisition stage. Although it constitutes the limitation of this research, the findings obtained are consistent and effective in revealing possible recreational areas. However, in subsequent studies, comprehensive and comparable research can be carried out by including many physical parameters, such as height related to recreation and proximity to rivers and streams.

5. Conclusions

In the study, slope, aspect, erosion, proximity to natural areas, proximity to water sources, proximity to roads, and proximity to residential areas were used to derive these results.

As a result of the study, it was observed that suitable recreational areas in the Adana province, Çukurova district are those close to roads, settlements, and natural landscapes, with low erosion and slope, indicating high suitability. Moderately suitable areas are near residential areas, roads, and dams, and are relatively close to natural landscapes. Areas with low suitability are primarily characterized by steep slopes and high erosion. The areas identified in the southwest and northwest are not considered suitable for recreational purposes due to their distance from roads and settlements. A significant factor in the low suitability areas within the city is their distance from the natural landscape, despite being close to roads and settlements. Furthermore, low suitability areas in the northeast lack recreational potential because of their distance from roads, even though they are close to the natural landscape. The study suggests that the diverse land uses in the identified recreation areas, such as waterfront, forest, and agricultural regions, will cater to the varied recreational needs of the district population. Suitable recreation areas in other parts of the district will also meet the demands of the growing population. One of the recommended recreation areas is located north of the Seyhan Dam Lake, where the close physical and ecological relationship with the lake enhances its suitability. Additionally, the western region of Seyhan Dam Lake is another area with recreational potential, including agricultural and forest lands. For areas intertwined with agricultural lands, a rural recreation type, including complementary uses like holiday farms, camping, and picnic areas, should be considered.

References

Adana Development Alliance Foundation. (1999). *Socio-economic report.* Adana Power Union Foundation, Adana.

Aronson, M. F., Lepczyk, C. A., Evans, K. L., Goddard, M. A., Lerman, S. B., MacIvor, J. S., Nilon, C., & Vargo, T. (2017). Biodiversity in the city: Key challenges for urban green space management. *Frontiers in Ecology and the Environment*, *15*(4), 189–196. https://doi.org/10.1002/fee.1480

Aşılıoğlu, F., & Çay, R. D. (2023). A dual spatial analysis method based on recreation opportunity spectrum and analyticalihierarchy process for outdoor recreation site suitability. *Journal of Outdoor Recreation and Tourism*, *44*, Article 100703. https://doi.org/10.1016/j.jort.2023.100703

Balogh, P. I., & Takács, D. (2011). The significance of urban open spaces and green areas in urban property developments. In *First International Conference "Horticulture and Landscape Architecture in Transylvania" Agriculture and Environment Supplement* (pp. 110–121), Cluj-Napoca, Romania. Scientia Publishing House.

Bolund, P., & Hunhammar, S. (1999). Ecosystem services in urban areas. *Ecological Economics*, *29*(2), 293–301. https://doi.org/10.1016/S0921-8009(99)00013-0

Caglayan, I., Yeşil, A., Cieszewski, C., Gul, F. K., & Kabak, O. (2020). Mapping of recreation suitability in the Belgrad Forest Stands. *Applied Geography*, *116*, Article 102153. https://doi.org/10.1016/j.apgeog.2020.102153

Canhasi, E. (2010). *Analytical hierarchy process* [Master's thesis, Mimar Sinan Fine Arts University]. Istanbul, Turkey.

Çelik, A., & Şenay, D. (2023). Opportunities of using rural areas for recreational purposes: The case of the Karacabey District, Bursa Province. *Journal of Agriculture Faculty of Ege University*, *60*(1), 1–17. https://doi.org/10.20289/zfdergi.1182317

Chhetri, P., & Arrowsmith, C. (2008). GIS-based modelling of recreational potential of nature-based tourist destinations. *Tourism Geographies*, *10*(2), 233–257. https://doi.org/10.1080/14616680802000089

Cilliers, E. J. (2015). The importance of planning for green spaces. *Agriculture, Forestry and Fisheries*, *4*(4–1), 1–5. https://doi.org/10.11648/j.aff.s.2015040401.11

Dağıstanlı, C., Turan, İ. D., & Dengiz, O. (2018). Evaluation of the suitability of sites for outdoor recreation using a multi-criteria assessment model. *Arabian Journal of Geosciences*, *11*, 1–14. https://doi.org/10.1007/s12517-018-3856-0

Derr, V., Ruppi, H., & Wagner, D. (2016). Honoring voices, inspiring futures: Young people's engagement in open space planning. *Children, Youth and Environments*, *26*(2), 128–144. https://doi.org/10.1353/cye.2016.0006

Dong, Y., Jin, G., Deng, X., & Wu, F. (2021). Multidimensional measurement of poverty and its spatio-temporal dynamics in China from the perspective of development geography. *Journal of Geographical Sciences*, *31*(1), 130–148. https://doi.org/10.1007/s11442-021-1836-x

Duku, E., Mensah, C. A., Amadu, I., & Adzigbli, W. K. (2023). Changes in urban green spaces in coastal cities and human well-being: The case of Cape Coast Metropolis, Ghana. *Geo: Geography and Environment*, *10*(1), Article e00119. https://doi.org/10.1002/geo2.119

Ebrahimi, M., Nejadsoleymani, H., & Mansouri Daneshvar, M. R. (2019). Land suitability map and ecological carrying capacity for the recognition of touristic zones in the Kalat region, Iran: A multi-criteria analysis based on AHP and GIS. *Asia-Pacific Journal of Regional Science*, *3*(3), 697–718. https://doi.org/10.1007/s41685-019-00123-w

Erdogan, Ö., Cabuk, A., Memluk, Y., & Percin, H. (2013). Ekolojik alan kullanım kararlarına uygun rekreasyon alanlarının AHP yöntemi kullanılarak Kütahya kenti örneğinde irdelenmesi [Evaluation of recreation areas according to ecological land use decisions: The example of the City of Kütahya using the AHP method]. *Harita Teknolojileri Elektronik Dergisi*, *5*(1), 26–36.

Gelan, E. (2021). GIS-based multi-criteria analysis for sustainable urban green spaces planning in emerging towns of Ethiopia: The case of Sululta town. *Environmental Systems Research*, *10*, 1–14. https://doi.org/10.1186/s40068-021-00220-w

Gold, S. M. (1980). *Recreation planning and design*. McGraw Hill Book Company.

Gul, A., Orucu, M. K., &Karaca, O. (2006). An approach for recreation suitability analysis to recreation planning in Gölcük Nature Park. *Environmental Management*, *37*, 606–625. https://doi.org/10.1007/s00267-004-0322-4

Gunal, I. (2010). *Determination of open-green area potential of Soma (Manisa) district* [Master's thesis, Canakkale Onsekiz Mart University]. Canakkale, Turkey.

Gurses, I. (1970). Green and free space policy. *Journal of Landscape Architecture*, *1*(1).

Guzzetti, F., Carrara, A., Cardinali, M., Reichenbach, P., Galli, M., & Ardizzone, F. (1999). Landslide hazard evaluation: An aid to a sustainable development. *Geomorphology*, *31*(1–4), 181–216. https://doi.org/10.1016/S0169-555X(99)00078-1

Haq, S. M. A. (2011). Urban green spaces and an integrative approach to sustainable environment. *Journal of Environmental Protection*, *2*, 601–608. https://doi.org/10.4236/jep.2011.25069

Herath, G., & Prato, T. (2006). *Using multi-criteria decision analysis in natural resource management*. Ashgate Publishing Company.

Keles, R. (1980). *Dictionary of urbanistic terms*. Turkish Language Association Publications.

Krämer, A., & Roth, R. (2002). Spatial requirements of outdoor sports in the Nature Park Southern Blackforest-GIS-based conflict analysis and solutions for visitor flow management. In A. Arnberger, C. Brandenburg, & A. Muhar (Eds.), *Monitoring and Management of Visitor Flows in Recreational and Protected Areas Conference Proceedings* (pp. 33–39). https://mmv.boku.ac.at/refbase/files/kramer_alexander_r-2002-spatial_requirements.pdf

Lin, C. L. (2020). Establishing environment sustentation strategies for urban and rural/town tourism based on a hybrid MCDM approach. *Current Issues in Tourism*, *23*(19), 2360–2395. https://doi.org/10.1080/13683500.2019.1642308

Lu, Y., Han, F., Liu, Q., Wang, Z., Wang, T., & Yang, Z. (2022). Evaluation of potential for nature-based recreation in the Qinghai-Tibet Plateau: A spatial-temporal perspective. *International Journal of Environmental Research and Public Health*, *19*(9), Article 5753. https://doi.org/10.3390/ijerph19095753

Luo, Q., Bao, Y., Wang, Z., & Chen, X. (2022). Potential recreation service efficiency of urban remnant mountain wilderness: A case study of Yunyan District of Guiyang city, China. *Ecological Indicators*, *141*, Article 109081. https://doi.org/10.1016/j.ecolind.2022.109081

Lynch, A. J. (2021). The role and potential of residential open space in a suburban green space network. *Urban Forestry & Urban Greening*, *58*, Article 126971. https://doi.org/10.1016/j.ufug.2020.126971

McDonald, R. I., Forman, R. T., & Kareiva, P. (2010). Open space loss and land inequality in United States' cities, 1990–2000. *PLoS ONE*, *5*(3), Article e9509. https://doi.org/10.1371/journal.pone.0009509

Mensah, C. A. (2014). Destruction of urban green spaces: A problem beyond urbanization in Kumasi city (Ghana). *American Journal of Environmental*, *3*(1), 1–9. https://doi.org/10.11648/j.ajep.20140301.11

Miyachi, T., Watanabe, K., Tachiiri, K., & Gotoh, K. (2003). Selecting location of urban parks with GIS in Nagasaki City. *Reports of the Faculty of Engineering, Nagasaki University*, *33*(61), 97–101.

Nordh, H., Alalouch, C., & Hartig, T. (2011). Assessing restorative components of small urban parks using conjoint methodology. *Urban Forestry & Urban Greening*, *10*(2), 95–103. https://doi.org/10.1016/j.ufug.2010.12.003

Osorio, B. G., Viteri, L. E., & Vlassova, L. (2022). Ecosystem services of urban green spaces: Multicriteria spatial analysis model. *NeuroQuantology*, *20*(6), 1678–1684.

Ozcan, O., Musaoglu, N., & Seker, D. Z. (2009, May 11–15). *Determination of flood areas with the help of GIS and remote sensing and risk management: Sakarya basin example* [Paper presentation]. TMMOB Chamber of Surveying and Cadastre Engineers 12th Turkish Mapping Scientific and Technical Congress, Ankara.

Ozturk, D., & Batuk, F. (2010). Analytic hierarchy process for spatial decision making. *Sigma*, *28*(2), 124–137.

Ozugul, M. D. (2012). Ekolojik planlama. In M. Ersoy (Ed.), *Kentsel planlama ansiklopedik sözlük* (pp. 107–112). İstanbul, Ninova.

Paudel, S., & States, S. (2023). Urban green spaces and sustainability: Exploring the ecosystem services and disservices of grassy lawns versus floral meadows. *Urban Forestry & Urban Greening*, *84*, Article 127932. https://doi.org/10.1016/j.ufug.2023.127932

Prance, G. T., Dixon, G. R., & Aldous, D. E. (2014). Biodiversity and green open space. In *Horticulture: Plants for people and places*

(Vol. 2, pp. 787–816). Springer. https://doi.org/10.1007/978-94-017-8581-5_9

Saaty, R. W. (1987). The analytic hierarchy process-what it is and how it is used. *Mathematical Modelling*, *9*(3–5), 161–176. https://doi.org/10.1016/0270-0255(87)90473-8

Saaty, T. L. (1980). *The analytic hierarchy process*. McGraw-Hill. https://doi.org/10.21236/ADA214804

Santos, T., Mendes, R. N., & Vasco, A. (2016). Recreational activities in urban parks: Spatial interactions among users. *Journal of Outdoor Recreation and Tourism*, *15*, 1–9. https://doi.org/10.1016/j.jort.2016.06.001

Soeters, R., & Van Westen, C. J. (1996). Slope instability recognition, analysis and zonation. In *Landslides: Investigation and mitigation* (Vol. 247, pp. 129–177). National Academy Press.

Sohrab, S. M., Oladi-Ghadikolaiee, J., & Jalilvand, H. (2020). Recreational zoning of Natural forest parks using Analytic hierarchy process and geographic information system (Case study: Talar Forest Park, Qaemshahr, Iran). *Journal of Biochemical Technology*, *11*(1), 46–52.

Srdjevic, B., Srdjevic, Z., Reynolds, K. M., Lakicevic, M., & Zdero, S. (2022). Using analytic hierarchy process and best–worst method in group evaluation of urban park quality. *Forests*, *13*(2), Article 290. https://doi.org/10.3390/f13020290

Steiner, F., McSherry, L., & Cohen, J. (2000). Land suitabilityanalysis for the upper Gila River watershed. *Landscape and Urban Planning*, *50*, 199–214. https://doi.org/10.1016/S0169-2046(00)00093-1

Swanwick, C., Dunnett, N., & Woolley, H. (2003). Nature, role and value of green space in towns and cities: An overview. *Built Environment*, *29*(2), 94–106. https://doi.org/10.2148/benv.29.2.94.54467

Toapanta Orbea, L. A., Leyva Vazquez, M., & Hechavarría Hernández, J. R. (2021). AHP applied to the prioritization of recreational spaces in green Areas. Case study: Urban area of the El Empalme Canton, Ecuador. In T. Ahram (Ed.), *Advances in intelligent systems and computing: Vol. 1213. Advances in artificial intelligence, software and systems engineering* (pp. 292–297). Springer. https://doi.org/10.1007/978-3-030-51328-3_41

Turgut, H., Ozalp, A. Y., & Akıncı, H. (2021). Introducing the Hiking Suitability Index to evaluate mountain forest roads as potential hiking routes – a case study in Hatila Valley National Park, Turkey. *Journal on Protected Mountain Areas Research and Management*, *13*(1), 55–66. https://doi.org/10.1553/eco.mont-13-1s55

Turkish Statistical Institute. (2021). *Population and demography*. https://data.tuik.gov.tr/Kategori/GetKategori?p=Nufus-ve-Demografi-109

Vaznonienė, G., & Vaznonis, B. (2017). Social benefit of green spaces to local community. *Rural Development*, *8*, 1380–1385. https://doi.org/10.15544/RD.2017.214

Voigt, A., Kabisch, N., Wurster, D., Haase, D., & Breuste, J. (2014). Structural diversity: a multi-dimensional approach to assess recreational services in urban parks. *Ambio*, *43*, 480-491. https://doi.org/10.1007/s13280-014-0508-9

Wang, Y., Tian, Y., & Cao, Y. (2021). Dam siting: a review. *Water*, *13*(15), Article 2080. https://doi.org/10.3390/w13152080

Wolff, M., & Haase, D. (2019). Mediating sustainability and liveability turning points of green space supply in European cities. *Frontiers in Environmental Science*, *7*, Article 61. https://doi.org/10.3389/fenvs.2019.00061

World Health Organization. (2016). Urban green spaces and health (No. WHO/EURO: 2016-3352-43111-60341). https://www.who.int/europe/publications/i/item/WHO-EURO-2016-3352-43111-60341

World Health Organization. (2017). *Urban green spaces: A brief for action*. https://www.who.int/europe/publications/i/item/9789289052498

Yıldızcı, A. C. (1982). *Urban green area planning and Istanbul example* [Unpublished associate professor thesis]. Istanbul Technical University.

Zhou, W., & Troy, A. (2008). An object-oriented approach for analyzing and characterizing urban landscape at the parcel level. *International Journal of Remote Sensing*, *29*(11), 3119–3135. https://doi.org/10.1080/01431160701469065

Zhou, X., & Rana, M. P. (2012). Social benefits of urban green space: A conceptual framework of valuation and accessibility measurements. *Management of Environmental Quality: An International Journal*, *23*(2), 173–189. https://doi.org/10.1108/14777831211204921