PLANNING, DESIGN AND MANAGEMENT IN LANDSCAPE ARCHITECTURE

Editor

Assoc. Prof. Dr. Arzu ALTUNTAŞ

İKSAD
Publishing House

PLANNING, DESIGN AND MANAGEMENT IN LANDSCAPE ARCHITECTURE

EDITOR:

Assoc. Prof. Dr. Arzu ALTUNTAŞ

AUTHORS:

Prof. Dr. Bahar TÜRKYILMAZ
Prof. Dr. Bahriye GÜLGÜN
Prof. Dr. Murat Ertuğrul YAZGAN
Prof. Dr. Namık Kemal SÖNMEZ
Prof. Dr. Şevket ALP
Prof. Dr. Veli ORTAÇEŞME
Assoc. Prof. Dr. Ahmet BENLİAY
Assoc. Prof. Dr. Arzu ALTUNTAŞ
Assoc. Prof. Dr. İsmail ÇINAR
Assoc. Prof. Dr. Kübra YAZİCİ
Assoc. Prof. Dr. Rifat OLGUN
Assoc. Prof. Dr. Serdar SELİM
Assist. Prof. Dr. Betül TÜLEK
Assist. Prof. Dr. Ceren SELİM
Assist. Prof. Dr. Merve ERSOY MİRİCİ
Assist. Prof. Dr. Mustafa ERGEN
Assist. Prof. Dr. Pınar BOSTAN
Assist. Prof. Dr. Zeynep Rabiye ARDAHANLIOĞLU
Lecturer Nihat KARAKUŞ
Dr. Gökhan BALIK
Dr. Pelin ŞAHİN KÖRMEÇLİ
Research Assistant Selin TEMİZEL
Agricultural Engineer Mesut ÇOŞLU
Azad AHMED
Karzan ABDULAZEEZ
Laween HASHIM
Mahmood I. ALBRIFKANY
Sardar M. SALIH
Selin ERDOĞAN

İKSAD Publishing House

Institution of Economic Development and Social Researches Publications®
(The Licence Number of Publicator: 2014/31220)
TURKEY TR: +90 342 606 06 75
USA: +1 631 685 0 853
E mail: iksadyayinevi@gmail.com
www.iksadyayinevi.com

ISBN: 978-625-7636-65-0
Cover Design: Arzu ALTUNTAŞ
May / 2021
Ankara / Turkey
Size = 16x24 cm

CONTENTS

PREFACE

Landscape Architecture is a professional discipline that creates spaces by creating a harmonious intersection with natural, cultural and social factors in line with ecological, functional, aesthetic and economic goals. It aims to guide the effects and interactions between landscape and human in the right way within the balance of protection / use by keeping sustainability at the forefront in the protection of natural resources. Landscape architecture should not be considered as an art only with aesthetic concerns or as a science with only functional purposes. From this point of view, it is inevitable for landscape architects to use different working methods in achieving the goals and objectives required by the profession and to consider the profession from different angles. Landscape architecture is an art and science branch with different approaches such as planning, design, management and engineering. This book contains invaluable studies containing information about the planning, design and management aspects of landscape architecture.

I would like to thank the authors who contributed to this study with their chapter articles and made us use of their valuable ideas and research. I would also like to thank Assoc. Prof. Dr. Seyithan SEYDOŞOĞLU and IKSAD Publishing staff for their support and knowledge during the formation and publication stages of the book. I hope the book will be useful for the scientific world and anyone interested in landscape architecture.

Sincerely yours

Assoc. Prof. Dr. Arzu ALTUNTAŞ

May, 2021

CHAPTER 1

EVALUATION OF THE RELATIONSHIP BETWEEN LAND USE AND LAND SURFACE TEMPERATURE IN MANAVGAT SUB-BASIN

Agricultural Engineer Mesut ÇOŞLU [1*]
Lecturer Nihat KARAKUŞ [2]
Assoc. Prof. Dr. Serdar SELİM [3]
Prof. Dr. Namık Kemal SÖNMEZ [4]

[1*] Akdeniz University, Remote Sensing Application and Research Centre, Antalya, Turkey. E-mail: mesutcoslu@akdeniz.edu.tr. ORCID ID: 0000-0003-3952-6563
[2] Akdeniz University, Vocational School of Serik Gülsün-Süleyman Süral, Department of Park and Horticulture, Antalya, Turkey. E-mail: nkarakus@akdeniz.edu.tr ORCID ID: 0000-0002-6924-1879
[3] Akdeniz University, Faculty of Science, Department of Space Science and Technologies, Antalya, Turkey. E-mail: serdarselim@akdeniz.edu.tr ORCID ID: 0000-0002-5631-6253
[4] Akdeniz University, Faculty of Science, Department of Space Science and Technologies, Antalya, Turkey. E-mail: nksonmez@akdeniz.edu.tr ORCID ID: 0000-0001-6882-0599

INTRODUCTION

Climate change, rapid population growth, unplanned structuring, unconscious use of natural resources, changes in the quality and quantity of water resources have determined environmental problems on a global scale as the most important agenda of the world (Singh and Singh, 2017). Agricultural industrialization, the construction of agricultural lands, the construction of large transportation networks without considering the natural and cultural structure cause serious degradation in natural and cultural landscapes (Baude et al., 2019), significant losses in habitats (Fardila et al., 2017), and the ecological structure of water basins is changing, ecological habitats are destroyed and fragmented, especially as a result of anthropogenic factors (Nathaniel et al., 2021). Land cover in urban and rural landscapes is changing with an increasing acceleration, and the ecological structure of water basins is deteriorating (Nendel et al., 2018). Bring this change under control within the scope of ensuring the continuity of ecological systems, reducing the pressure on nature, ensuring the sustainability of urban and rural landscapes is only possible by planning, protecting and managing these environments with an integrated approach.

In particular, the protection and sustainability of water resources, which are essential for life, are of great importance for future generations. The negative changes that occur in water basins due to global climate change and temperature increases force countries to adopt approaches towards the protection of water basins (Wang et al., 2018). Watershed-based studies on water resources in Turkey has accelerated since the

1930s. The main objectives of those times were engineering studies within the scope of developing water resources to meet vital needs and preventing damages caused by water floods (Selim and Kaplan, 2016). In the following period, it is aimed to stop the natural resources and environmental degradation process ongoing for years in 25 sub-catchment basins in Turkey. In addition, it is aimed to determine and implement the 'integrated' natural resource management framework and strategy in order to protect flora and fauna, control ecosystem integrity, and increase the welfare level of the population living in the basin. (Selim, 2015). However, during the period until the present day, in made in planning for river basins in Turkey, disputes between regional and local plans scale, implementation problems, not offering an integrated conservation and utilization strategy of current conservation status, inability participation is achieved, the continuing deterioration in the social structure and ecological characteristics of the basin, it seems that current master plans are insufficient and incomplete. Therefore, in the planning studies for the basins, it is necessary to first determine the ecological boundaries of the basins, determine the current land use and evaluate their suitability for the function subject to planning. (Barrow, 1998; Azevedo et al., 2000; Gohari et al., 2017). Especially for agricultural planning, it is necessary to reveal the effect of temperatures caused by global warming and temperature changes on the surface. Air and surface temperature are also important in terms of settlement and thermal comfort, as well as agricultural product pattern (Sharma et al., 2021). The effects of global warming should not be ignored in integrated planning studies for the basin, such as the selection of urbanization areas and the determination of the areas planned to be opened to agriculture, and it should be included in the planning processes together with the current land use status (Sun et al., 2019; Li et al., 2021).

Existing land use is the most important factor in the future planning studies of the basins, directing the applications (Liang et al., 2017). Therefore, determining the current land use with high accuracy is essential for planning studies. In this context, determination of basin boundaries and characteristics with the help of Remote Sensing (RS) and Geographic Information Systems (GIS) technologies can be performed in a very short time compared to traditional methods. (Enoguanbhor et al., 2019). In particular, data such as digital elevation models, basin and sub-basin areas, water flow directions, drainage networks come to the fore as a data source that can be used to produce basin characteristics. (Akkaya Aslan et al., 2004; Gökgöz et al., 2019; Kim et al., 2020). Today, although SRTM and ASTER DEM data seem to be in the foreground, ALOS PALSAR DEM data with a spatial resolution of 12.5 m are frequently used especially in such hydrological analysis with higher spatial resolution. (Jothimani et al., 2020; Nitheshnirmal et al., 2020; Niipele and Chen 2019). In this context, high spatial resolution and open source ALOS PALSAR data were used in this study to determine Manavgat sub-basin boundaries and some basin characteristics. Besides, land surface temperature (LST) is an important variable in the climate system (Bian et al., 2017). LST affects the rate and timing of plant growth, as well as explaining processes such as energy and water exchange between the land surface and the atmosphere. A correct understanding of the LST at the global and regional level helps to evaluate land surface-atmosphere change processes in models and provides a valuable measure of surface condition when combined with other physical properties such as vegetation and soil moisture (ESA, 2020). LST, in the simplest terms, is the earth's crust temperature (Zhang et al., 2006). LST is directly related to land use and land cover, and temperature may differ depending on the type of materials (Polat, 2020). LST, which is different from the air temperature and expresses the radiative surface temperature of the land surface, affects the sharing of energy between soil and vegetation and determines the surface air temperature (Copernicus, 2020). LST is an important parameter related to surface energy and water balance at local and global scales. Therefore, the inclusion of LST in watershed planning studies is important for the sustainability of water balance and temperature various methodologies have been developed to extract LST from space-based thermal infrared (TIR) data (Li and Duan 2018). Among these the split window method, temperature / emissivity separation method, the single mono window algorithm, the single channel method are the most commonly used algorithms. (Sobrino et al., 1996; Gillespie et al., 1998; Qin et al., 2001; Jimenez Munoz and Sobrino, 2003; Şekertekin et al., 2015). In this study, in order to interpret the current land use situation in the basin with LST, which is an important variable in the climate system, the red, near infrared and thermal bands of the Landsat 8 satellite were used to calculate the reflected temperature values from the ground surface in degrees Celsius.

In this study, the relationship between the current land use and land surface temperature of Manavgat sub-basin in Antalya Province, one of the most important tourism and agricultural destination of Turkey's, was determined, a comprehensive data set was created for the spatial planning for the basin and recommendations were developed. In this direction, firstly, the sub-basin boundary was determined automatically with the help of remote sensing and geographical information systems based on ecological thresholds and the current land use was classified. Then, satellite images were used to determine the land surface temperature for the basin, and surface temperature maps were obtained with the help of successive algorithms. The positive and negative relationships between the current land use and surface temperature were evaluated on the basis of basin planning and global climate change, and recommendations for the basin were developed.

1. MATERIAL AND METHOD

This study consists of the basic stages of determining the research area and obtaining the data, pre-processing the data, analysing the datasets and evaluating the obtained findings.

1.1. Study Area

The area shown in Figure 1 was chosen as the study area, considering the neighbouring sub-basin boundaries in the data obtained from DSI

(The General Directorate of State Hydraulic Works). Three sub-basins in the study area cover a large part of Serik, Manavgat, Alanya, İbradı and Akseki districts and a part of Isparta province.

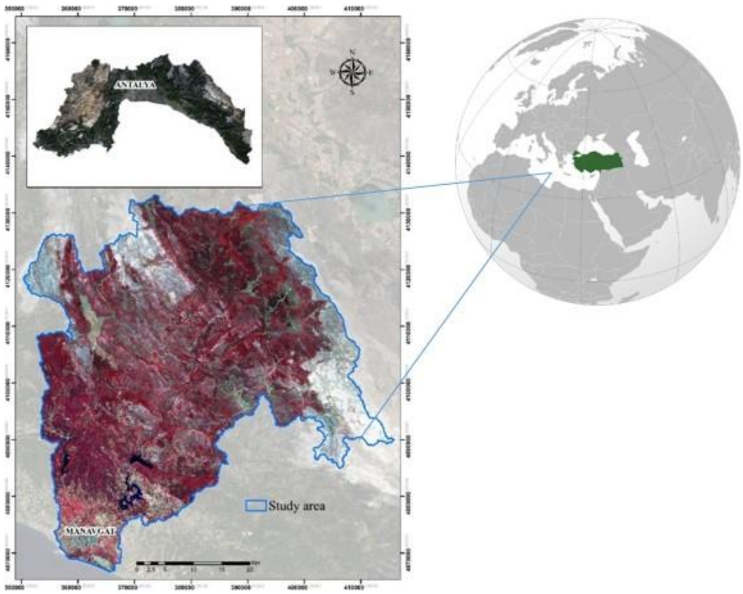


Figure 1. Study area (false colour band combination)

The length of the Manavgat River, which originates in the Taurus Mountains and flows into the Mediterranean in Antalya, is 93 km. The river is formed by the joining of the tributaries originating from the Western Taurus mountain range. Turning to the southwest, it passes through narrow and steep canyons and forms the Manavgat Waterfall, which is an important centre in terms of tourism.

1.2 Datasets Used in Determining the Study Area

The study area was determined using PALSAR image from 3 sensors (PRISM, ANVIR-2, PALSAR) located on ALOS satellite developed by JAXA (Japanese Space Agency). PALSAR is capable of imaging day and night without being affected by weather conditions and provides images with a spatial resolution of 10-100 m. ALOS satellite images can be used in studies such as high-resolution digital elevation model (DEM), land use and land cover mapping, ecosystem, agriculture and forestry research (NİK, 2020).

High resolution DEM data used in the study can be obtained free of charge from Alaska Satellite Facility (ASF). In order to compare and evaluate the Manavgat sub-basin boundaries produced within the scope of the study, the vector data prepared with 30 m spatial resolution satellite image and ground control by DSI were used as reference data.

1.3 Datasets Used to Determine the LST

Landsat 8 orbits the Earth in a sun-synchronous, near-polar orbit, at an altitude of 705 km, inclined at 98.2 degrees, and completes one Earth orbit every 99 minutes (USGS, 2020). The Landsat 8 satellite used in the study provides medium resolution data from 15 meters to 100 meters. Within the scope of this study, the 4th Band (Red), 5th Band (Near Infrared-NIR) and 10th (Thermal) bands of the Landsat 8 satellite dated August 8, 2018 were used to obtain the LST (Table 1).

Table 1. Landsat 8 spectral bands used in the study (USGS, 2020)

Spektral range	Wavelength	Resolution
Band 4 - Red	0.64 - 0.67µm	30 m
Band 5 - Near-Infrared	0.85 - 0.88 µm	30 m
Band 10 - TIRS 1	10.6 - 11.19 µm	100 m

1.4 Datasets Used to Assess the Relationship between Land Use Land Cover (LULC) and LST

CORINE (Coordination of Information on the Environment) land cover inventory studies started in 1985. It has been produced in 2000, 2006, 2012 and 2018 with reference to the year 1990. CORINE consists of a land cover inventory in 44 classes. The latest CORINE 2018 version, which is also used within the scope of this study, was produced in less than one year. (Copernicus, 2021).

1.5 Method

1.5.1 Sub-basin boundry detection

This stage consists of sub-process of pre-processing the data and determining the basin boundaries. Within the scope of the study, 61 image frames belonging to the specified area were used. When the images were examined, because there were more than one images belonging to the same place in some parts of the area, they were eliminated from the database. As a result, it was decided to use 14 images for this study area. At this stage, the images to be analysed and the vector data showing the existing basin and sub-basin boundaries have been adjusted to the same projection and datum with the geometric correction. After this sub-process step, the images were combined with the mosaicking process. In order to reduce the density in the dataset, the working area was cut by subset process and the dataset was made ready for hydrology analysis.

The analysis technique used to determine the basin boundaries in the study is hydrology analysis. Hydrology analysis tools used in this study are used to model water flow across a surface. With hydrology analysis, it is mainly aimed to find out where the water comes from and where it goes, while at the same time, the flow of water can be modelled (ESRI, 2020).

In this study, hydrology tools found in ArcGIS software were used. Three process steps are generally used to create a raster that identifies all drainage basins in the study area with hydrology tools. At this stage of fill, it fills sinks in a surface raster to remove small imperfections in the data. At the stage of flow direction, it creates a raster of flow direction from each cell to its steepest downslope neighbour. At the stage of basin, it creates a raster delineating all drainage basins (ESRI, 2020).

Finally, Manavgat sub-basin boundaries produced as a result of hydrology analysis and two neighbouring sub-basin boundaries were compared with reference data and evaluated. In addition, at this stage, the slope and aspect analysis processes, which are among the basic surface analyses, were carried out on the DEM data subset according to the Manavgat sub-basin boundaries. Some characteristics of the Manavgat sub-basin were revealed through the data generated after this sub-process step.

1.5.2 LST detection

LST values of Manavgat sub-basin were determined in three sub-stages (Figure 2). In this context, in order to calculate the ground surface temperature, first the 10th band, thermal band, was used to convert the brightness values into radiance values, and then these radiance values were converted into temperature values. In the second sub-stage, NDVI image of the area was produced using the 4th and 5th bands and proportion of vegetation (PV) and emissivity were calculated using this image. In the last stage, the ground surface temperature image of the area was produced by using the temperature and emissivity values.

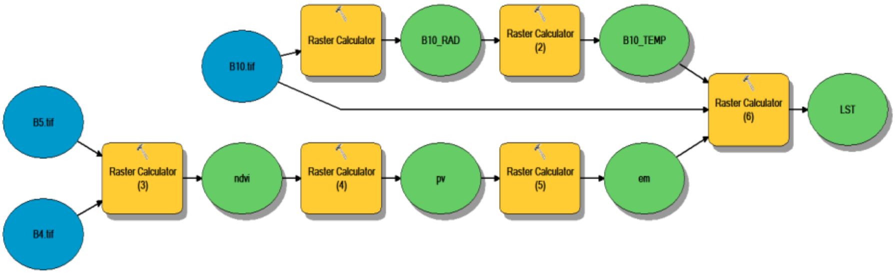


Figure 2. Model Builder for LST

The operations performed within the scope of the study and the equations used for the calculations are given in detail below.

- **Conversion to Top of Atmosphere (TOA) Radiance**

Equation (1) was used in the process of converting the brightness values of Band 10 from Landsat 8 satellite data to radiance values. With this conversion process, the brightness and contrast correction is made in the image. (USGS, 2021; Milder, 2008).

$$L_\lambda = M_L * Q_{cal} + A_L \tag{1}$$

Where:

L_λ = TOA spectral radiance (Watts/ (m^2 * sr * μm))

M_L = Radiance multiplicative band

A_L = Radiance add band

Q_{cal} = Quantized and calibrated standard product pixel values (USGS, 2021).

- **Conversion to Brightness Temperature (BT)**

For Landsat 8 thermal bands, with the help of equation (2), the conversion of radiance values to brightness temperature values is performed. K1 and K2 calibration constants in Equation (2) are 774.890 and 1321.079 for Landsat 8 satellites, respectively (USGS, 2021).

$$T = K_2 / \ln(K_1 / L_\lambda + 1) \tag{2}$$

Where:

B_T = Top of atmosphere brightness temperature (°C)

L_λ = TOA spectral radiance (Watts/(m^2 * sr * μm))

$K_1 = K_1$ Constant Band

$K_2 = K_2$ Constant Band

- **Land surface emissivity**

Emissivity is defined as the ratio of the total radiation incident to the object to the absorbed radiation. Emissivity can be calculated with the help of NDVI values. Normalized different vegetation index is calculated by a mathematical operation given in equation (3) between the near infrared and red band from the images whose reflectivity values are calculated.

$$NDVI = \rho NIR - \rho R / \rho NIR + \rho R \qquad (3)$$

Equations (4) and (5) can be used to calculate vegetation rate and emissivity using NDVI, respectively (Anandababu et al., 2018).

$$Pv = [NDVI - NDVI_{min} / NDVI_{max} - NDVI_{min}]^{2} \qquad (4)$$

$$\varepsilon = 0.004 * PV + 0.986 \qquad (5)$$

Where:

ε = Land Surface Emissivity

PV = Proportion of Vegetation

- **Land Surface emissivity retrieval**

After calculating the land surface emissivity and thermal radiance, atmospheric and emissivity correction is required. The following equation is used to make land surface emissivity correction in the measured temperature data on the sensor. (Artis ve Carnahan 1982).

$$Ts = B_T / \{1 + [\lambda * B_T / \rho]. Ln\varepsilon \qquad (6)$$

Where:

B_T = Top of atmosphere brightness temperature (°C)
λ = Wavelength of emitted radiance
ε = Land Surface Emissivity
ρ – (h x c/σ) = 1.438 x 10-2 = 14380mK

1.5.3 CORINE dataset

CORINE data for 2018 was used in order to evaluate the relationship between land surface temperature values and LULC. Then, these data were cut by subset operation according to the working area boundaries. CORINE data belonging to the study area was used in level one. For this purpose, the fields belonging to the lower levels are combined over this dataset. As a result, a four class LULC dataset was obtained since there is no wetland in the study area according to CORINE 2018.

2. RESULTS AND DISCUSSION

2.1 Sub-basin Boundary

12.5 m spatial resolution DEM data produced as a result of the mosaicking of ALOS PALSAR data, which is the basic data used in basin extraction, can be seen in Figure 3.

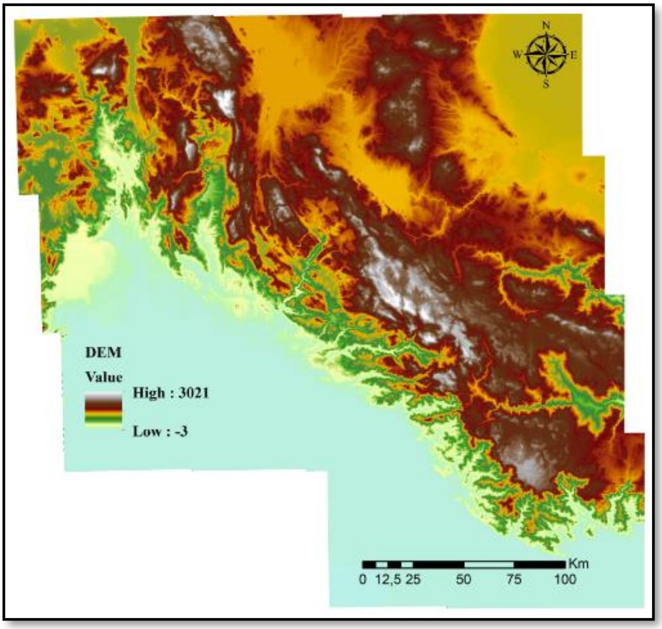


Figure 3. ALOS PALSAR Mosaic DEM data

The sub-basin boundaries given in Figure 4 were determined on the mosaiced dataset using filling, flow direction and basin tools in the hydrology analysis.

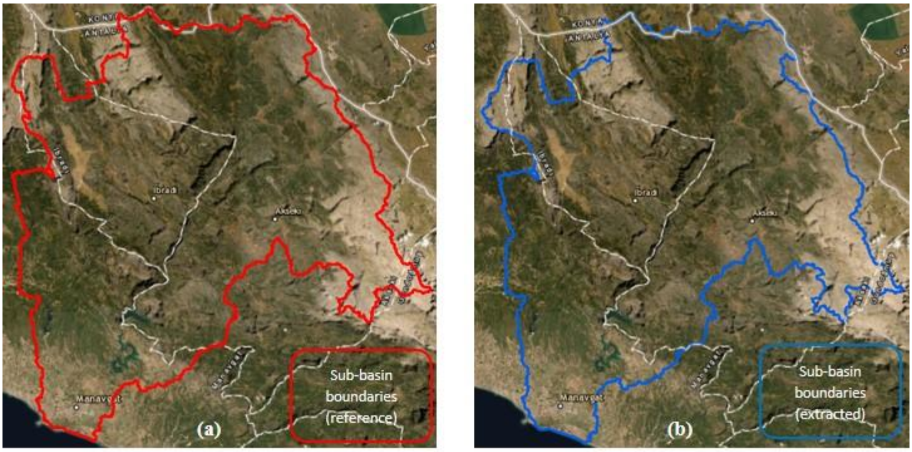


Figure 4. Manavgat sub-basin boundaries, reference (a); Extracted (b)

The Manavgat sub-basin aimed to be extracted within the scope of this study has been determined very successfully. As a result of the research findings, while the area containing the Manavgat sub-basin boundaries was 2412.85 km^2, it was determined that the area containing the same sub-basin was 2372.49 km^2 in the reference dataset used for evaluation in the study. The fact that the basin area obtained is 40.36 km^2 more than the reference data set is due to the high spatial resolution of the satellite image used.

According to the slope map of the Manavgat sub-basin extracted by hydrology analysis given in Figure 5, the average slope of the sub-basin is 16.73° in accordance with the reference dataset is 16.75°. In addition, the minimum height for the sub-basin is 26m, the average height is 1179.58m and the maximum height is 2775m. According to the reference dataset, the minimum height is 26 m, the average height is 1172.87m and the maximum height is 2762m.

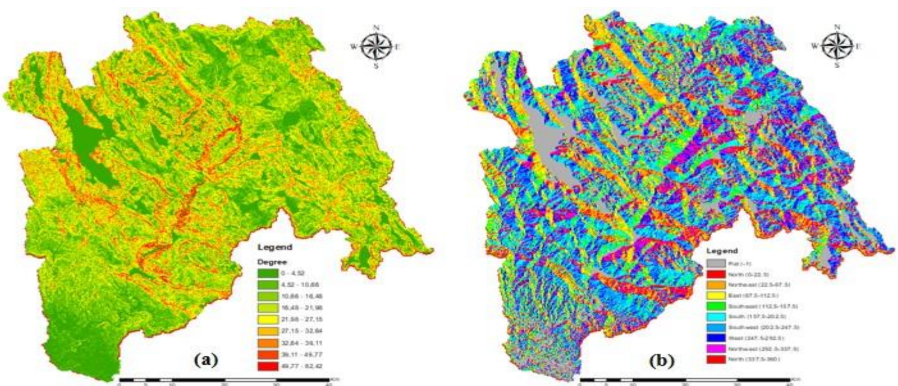


Figure 5. Extracted sub-basin slope map (a); aspect map (b)

In Table 2, some results regarding the characteristics of the Manavgat sub-basin extracted using hydrology tools are given and used as a reference for evaluation.

Table 2. Some characteristics of the Manavgat sub-basin

Sub-basin characteristics	Extracted	Reference	Difference
Sub-basin area (km^2)	2412.85	2372.49	40.36
Sub-basin perimeter (km)	359.11	416.19	57.08
Sub-basin minimum altitude (m)	26	26	-
Sub-basin average altitude (m)	1179.58	1172.87	6.71
Sub-basin maximum altitude (m)	2775	2762	13
Sub-basin aspect	Southwest	Southwest	-
Sub-basin average slope (degree)	16.73	16.75	0.02

It is clearly seen that there is compatibility with the reference data between the perimeter, minimum, maximum, average altitude and average slopes as well as the areal values of the Manavgat sub-basin boundaries. The differences between the produced sub-basin and the reference sub-basin values arise from the high-resolution DEM data used within the scope of the study. Therefore, this DEM data gives more precise and accurate results in basin extraction.

2.2 Sub-basin LST

The three bands (Band 4, Band 5, Band 10) used in the study were first cut by subset operation according to the Manavgat sub-basin boundaries and so the disadvantage of working with larger data was eliminated. The image obtained as a result of the process of converting the brightness values of the 10th band to radiance values and the radiance values to temperature values is given in Figure 6.

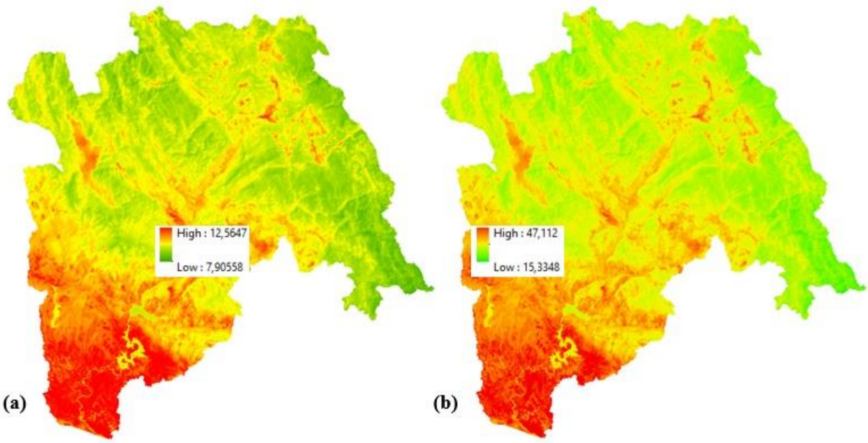


Figure 6. Conversion to TOA Radiance (a); Conversion to Brightness Temperature (BT) images (b)

NDVI, PV and emissivity images created in order to calculate the emissivity caused by the vegetation in the area within the scope of the study are shown in Figure 7.

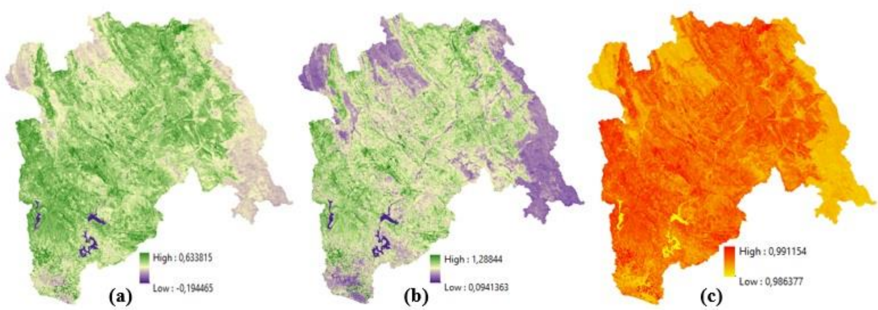


Figure 7. NDVI (a); Proportion vegetation (b); emissivity images (c)

With the three bands belonging to the Landsat 8 satellite dated August 8, 2018 used in this study, an image of the LST, which is one of the important parameters affecting the Manavgat sub-basin regional climate change, was obtained (Figure 8). According to the LST map, the lowest temperature in the area is 14.34 °C, while the highest temperature is 46.11 °C. According to the research findings, the average temperature of the sub-basin is 28.22 °C.

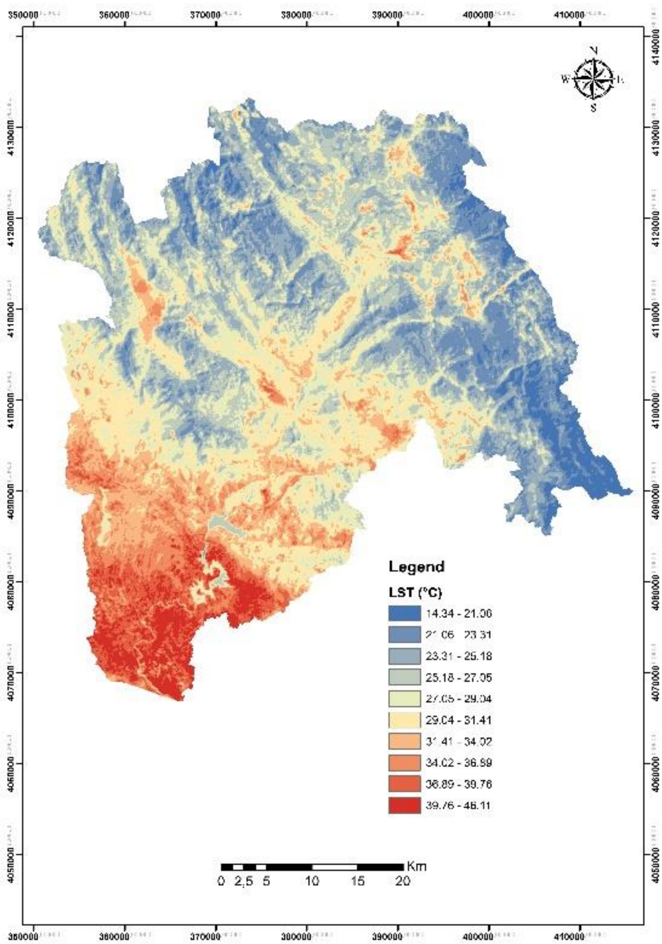


Figure 8. Sub-basin LST map

When the LST image of the study area is examined, it is seen that the temperature values are generally lower in the north of the area and higher in the south. In the image of the LST, the temperature values are generally high due to the low altitude and slope in the south of the area and the high number of settlements, while the water bodies in this area are lower than other land cover types. In the north of the study area, it is seen that the altitude and slope are high and the LST are low due to the mountainous / rocky nature of the area. In this region, areas with higher temperature values are generally settlements when it is compared to other low temperature cover types.

The current land use of the Manavgat sub-basin was obtained from CORINE 2018 data. 85.36% of Manavgat sub-basin consists of forest and semi-natural areas, 12.65% agricultural areas, 0.88% water bodies and 1.11% artificial surfaces. Manavgat city / city center, one of the artificial areas, is located in the south of the basin and where the slope is low. Rural settlements are located in areas with different heights within the basin, but where the slope is low. Agricultural areas are located on the periphery of urban and rural residential areas. While the agricultural areas within the basin spread over a wide area in the north, north east and east of Manavgat city / city center, they spread in smaller areas and in a fragmented structure in the periphery of rural residential areas. In forests and semi-natural areas within the basin, there are broad-leaved trees near stagnant water bodies and streams, and coniferous trees, shrubs and maquis in mountainous areas. Forest areas in the basin are mostly hollow.

In order to evaluate the relationship between land use and LST, the graphical data in Figure 9 was obtained by taking a cross-section in the southwest - northeast direction of the basin using the ArcGIS 3D Analyst Module. According to the graphic data obtained, the LST in residential areas has temperature values between 36.12 °C and 40.73 °C and the average LST is 39.30 °C. The 4.61 °C temperature difference in residential areas is due to the heterogeneous land cover of residential areas such as reinforced concrete structures, open areas and green areas. It has been observed that the surface temperature of the land is high in the areas where buildings and roads are located in the settlements, and the LST is lower in the open-green areas than the areas where the buildings and roads are located. As stated in some studies in the literature, the LST of city parks with dense vegetation can be up to 5 °C colder than the other urban land cover around it. In addition, trees help to cool the city and a 10% increase in the presence of green spaces in residential areas can cool the average surface temperature of the city to 4 °C (Spronken-Smith and Oke, 1998; Akbari, 2002; Gill et al., 2007; Watkins et al., 2007; Frumkin and McMichael, 2008).

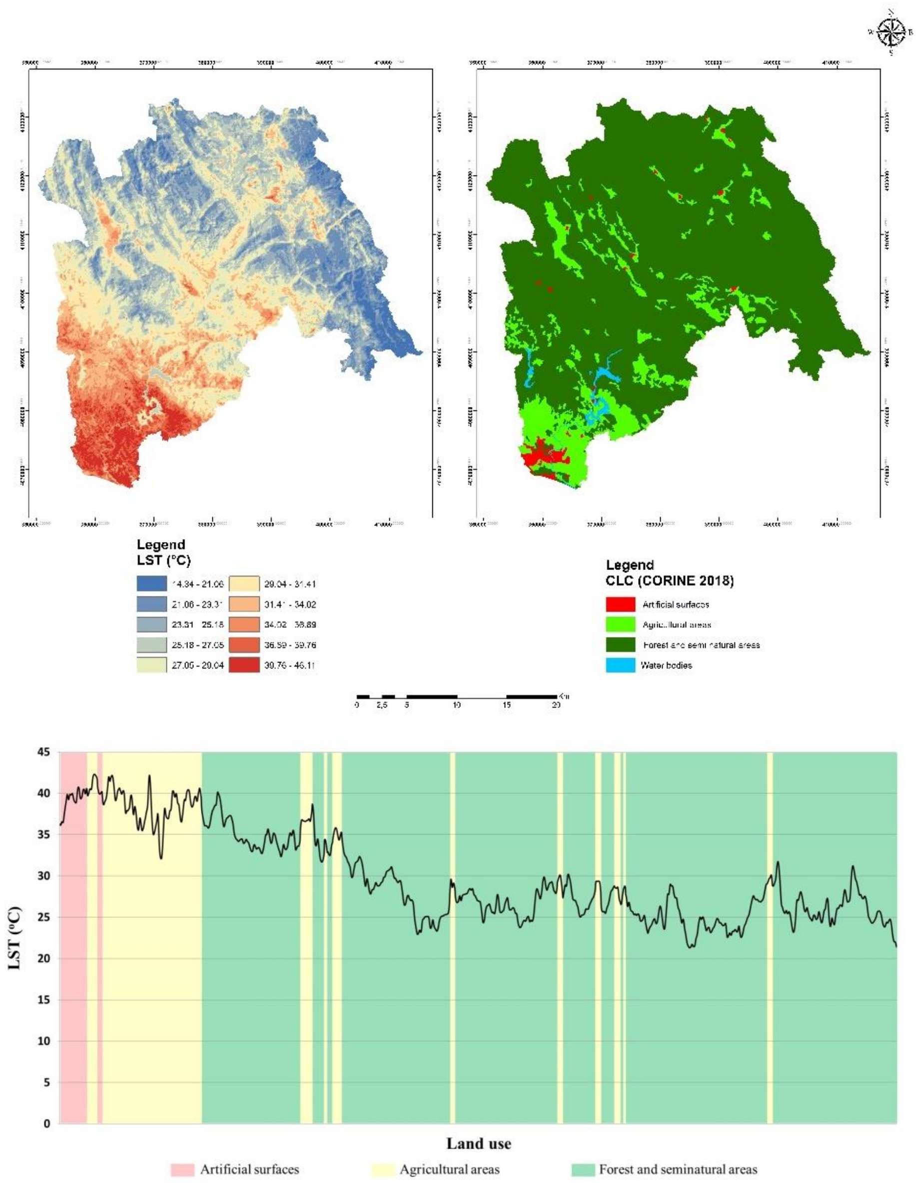


Figure 9. Relationship between LST and CLC in sub-basin

The LST in agricultural areas has temperature values between 26.85 °C and 42.29 °C and the average LST is 36.45 °C. The 15.44 °C temperature difference in agricultural areas is due to the variation of land cover in agricultural areas depending on time. Agricultural areas are generally areas where perennial, annual and seasonal plant production is carried out, and the land cover remains bare soil after harvesting especially seasonally produced plants. Since some of the agricultural areas in the basin had dense vegetation at the time of the study, they have lower LST. Since the plants were harvested at the time of the study in some agricultural areas, it was observed that the LST was higher than the agricultural areas with vegetation since the land cover was in bare soil. As stated in the literature, each plant species has a different surface temperature (Leuzinger and Körner, 2007). The difference in the area covered by each plant used in agricultural areas and the space between plants causes different temperature values in the same area. In addition, as stated in Duran (2007), the presence of different soil groups in close proximity in agricultural areas and different reflectivity and adhesion characteristics depending on the bedrock of each soil group cause different LST in agricultural areas with bare soil (Çelik, 2017).

The LST in forest and semi-natural areas has temperature values between 21.30 °C and 40.14 °C and the average LST is 27.89 °C. The temperature difference of 18.84 °C in forest and semi-natural areas is due to the variation in plant species and density of land cover in forests and semi-natural areas. It has been observed that the surface temperature of the land is high in areas where the plant density is low, and the surface temperature of the land is low in areas with high vegetation density and bare rocks due to the large amount of hollow structure in the land cover in forest and semi-natural areas.

3. CONCLUSION

This study was performed in Manavgat district of Antalya province which is one of Turkey's most important tourism and agricultural destinations. In the scope of the study, the boundaries of Manavgat sub-basin were determined with high precision and the relationship between current land use and LST was evaluated.

In the study, the boundaries of the Manavgat sub-basin were obtained using ALOS PALSAR - DEM image with a spatial resolution of 12.5 m. The basin boundary obtained is generally similar to the basin boundary prepared by DSI, which is used as a reference. However, the basin boundary differs by expanding in areas where the topography is active in the southeast, north east and especially in the northwest of the study area. It can be said that this difference is due to the use of high-resolution satellite imagery.

The lowest LST in the Manavgat sub-basin was determined as 14.34 °C in the forest and semi-natural area in the east of the basin. The highest LST was determined as 46.11 °C in the urban settlement area in the south of the basin. The average LST of the Manavgat sub-basin was determined to be 28.22 °C. It has been determined that there is a temperature difference of 31.77 °C between residential areas and forest areas in the basin. In addition, differences were observed in LST located in close proximity to each other in the basin. This difference can be explained by the heterogeneity of the land cover and the different reflection and absorption properties of each object on the land surface. In general, it was observed that the LST decreased from the southwest of the basin to the north east.

It has been determined that the LST is higher than the other land uses in Manavgat city / city center located in the south of the basin and the agricultural areas on its periphery. It has been determined that the rural settlements in a scattered structure within the basin and the LST of the agricultural areas on the periphery are higher than the forest and semi-natural areas. It has been observed that areas with higher plant density in forest areas have lower LST values than areas with lower plant density.

As a result, when the LST is evaluated together with the land use, it has been observed that open areas and concrete structures have high LST values, as in the studies in the literature, forest and semi-natural areas with high plant density and water structures have low LST values.

Changing climatic conditions and the increase in LST in the basin will cause negative effects on plant development, air and water quality, and will further increase the high temperature in urban areas. Increasing LST in urban areas reduces the thermal comfort of people living in the city. People living in the city will use more cooling systems to regenerate their thermal comfort, especially indoors, with increasing temperature, causing an increase in energy consumption, which has the largest share in total greenhouse gas emissions. For this reason, it is necessary to increase the green areas with high plant density and encourage the application of green roofs in order to provide thermal comfort and increase the sink area capacity in urban spaces within the scope of combating climate change. In this context, in all the planning to be made in the urban areas in the basin, the green infrastructure system should be integrated into spatial planning in order to combat changing climate conditions.

The findings obtained as a result of the analyses carried out in this study clearly show that remote sensing technology is an effective method in environmental observation and evaluation studies. Both visual and digital data to be obtained from these and similar studies are important in revealing features such as determining the parameters affecting the environment and monitoring them temporally, and measuring the temperature value of the land due to the limited number of meteorology stations.

Acknowledgments: The authors thank DSİ, USGS and ASF for providing data of charge.

REFERENCES

Akbari, H. (2002). Shade trees reduce building energy use and CO2 emissions from power plants. *Environmental pollution*, 116, S119-S126.

Akkaya Aslan, Ş., T., Gündoğdu, K., S., Demir, A., O. (2004). Sayısal Yükseklik Modelinden Yararlanılarak Bazı Havza Karakteristiklerinin Belirlenmesi: Bursa Karacabey İnkaya Göleti Havzası Örneği. *Uludağ Üniversitesi Ziraat Fakültesi Dergisi,* 18(1): 167-180.

Anandababu, D., Purushothaman B., M., and Babu, S., S. (2018). Estimation of Land Surface Temperature using LANDSAT 8 Data. *International Journal of Advance Research*, Ideas and Innovations in Technology. 4(2):177-86.

Artis, D., A., Carnahan, W. H. (1982). Survey of Emissivity Variability in Thermography of Urban Areas, *Remote Sensing of Environment.*

Azevedo, L. G. T. D., Gates, T. K., Fontane, D. G., Labadie, J. W. and Porto, R. L. (2000). Integration of water quantity and quality in strategic river basin planning. *Journal of water resources planning and management*, 126(2), 85-97.

Barrow, C. J. (1998). River basin development planning and management: a critical review. *World development*, 26(1), 171-186.

Baude, M., Meyer, B. C., and Schindewolf, M. (2019). Land use change in an agricultural landscape causing degradation of soil based ecosystem services. *Science of the Total Environment,* 659, 1526-1536.

Bian, T., Ren, G., and Yue, Y. (2017). Effect of urbanization on land-surface temperature at an urban climate station in North China. *Boundary-Layer Meteorology,* 165(3), 553-567.

Copernicus.(2020).Copernicuslandservice.https://land.copernicus.eu/global/products/lst#:~:text=The%20Land%20Surface%20Temperature%20(LST,direction%20of%20the%20remote%20sensor Accessed Date:18.02.2021

Copernicus.(2021).CORINELandCover.https://land.copernicus.eu/paneuropean/corine-land-cover. Accessed Date: 20.02.2021

Çelik, M. A. (2017). Split Window Yöntemi Kullanılarak Kireçtaşı ve Bazalt Üzerinde Yeryüzeyi Sıcaklıklarının (YYS) İncelenmesi. *Marmara Coğrafya Dergisi*, (36), 120-134.

Duran, C. (2007). Uzaktan algılama teknikleri ile bitki örtüsü analizi. *Doa Dergisi*, 13, 45-67.

Enoguanbhor, E. C., Gollnow, F., Nielsen, J. O., Lakes, T., and Walker, B. B. (2019). Land cover change in the Abuja City-region, Nigeria: Integrating GIS and remotely sensed data to support land use planning. *Sustainability*, 11(5), 1313.

ESA.(2020). Land Surface Temperature Project. https://climate.esa.int/en /projects/land-surface-temperature/. Accessed Date: 20.12.2020

ESRI.(2020).https://desktop.arcgis.com/en/arcmap/10.3/tools/spatial-analyst-toolbox/an-overview-of-the-hydrology-tools.htm. Accessed Date: 20.12.2020

Fardila, D., Kelly, L. T., Moore, J. L., and McCarthy, M. A. (2017). A systematic review reveals changes in where and how we have studied habitat loss and fragmentation over 20 years. *Biological Conservation*, 212, 130-138.

Frumkin, H., and McMichael, A. J. (2008). Climate change and public health: thinking, communicating, acting. *American journal of preventive medicine*, 35(5), 403-410.

Gohari, A., Mirchi, A., and Madani, K. (2017). System dynamics evaluation of climate change adaptation strategies for water resources management in Central Iran. *Water Resources Management*, 31(5), 1413-1434.

Gill, S. E., Handley, J. F., Ennos, A. R., and Pauleit, S. (2007). Adapting cities for climate change: the role of the green infrastructure. *Built environment*, 33(1), 115-133.

Gillespie, A.; Rokugawa, S.; Matsunaga, T.; Steven Cothern, J.; Hook, S.; Kahle, A.B. (1998). A temperature and emissivity separation algorithm for advanced spaceborne thermal emission and reflection radiometer (ASTER) images. *IEEE Trans. Geosci. Remote Sens.* 1998, 36, 1113–1126.

Gökgöz, T., Erdoğan, M., Seyrek, K., İ. Ozulu, M., İ. (2019). Batı Akdeniz Havzası Sınırlarının Yüksek Doğrulukla Belirlenmesi. *Teknik Dergi*, 2019 9073-9105, Yazı 535.

Jothimani, M., Dawit, Z. and Mulualem, W. (2020). Flood Susceptibility Modeling of Megech River Catchment, Lake Tana Basin, North Western Ethiopia, Using Morphometric Analysis. Earth Syst Environ (2020). https://doi.org/10.1007/s41748-020-00173-7.

Jiménez-Muñoz, J.C. Sobrino, J.A. (2003). A generalized single-channel method for retrieving land surfacetemperature from remote sensing data. *Journal of Geophysical Research,* Vol. 108, No. D22, 4688.

Kim, D.; Lee, H.; Jung, H.C.; Hwang, E.; Hossain, F.; Bonnema, M.; Kang, D. H.; Getirana, A. (2020). Monitoring River Basin Development and Variation in Water Resources in Transboundary Imjin River in North and South Korea Using Remote Sensing. *Remote Sens*. 2020, 12, 195.

Leuzinger, S., and Körner, C. (2007). Tree species diversity affects canopy leaf temperatures in a mature temperate forest. *Agricultural and forest meteorology*, 146(1-2), 29-37.

Li, X., Zhang, K., Gu, P., Feng, H., Yin, Y., Chen, W., and Cheng, B. (2021). Changes in precipitation extremes in the Yangtze River Basin during 1960–2019 and the association with global warming, ENSO, and local effects. *Science of The Total Environment*, 760, 144244.

Liang, J., Zhong, M., Zeng, G., Chen, G., Hua, S., Li, X., and Gao, X. (2017). Risk management for optimal land use planning integrating ecosystem services values: A case study in Changsha, Middle China. *Science of the Total Environment,* 579, 1675-1682.

Milder, J. C. (2008). ASTER processing method. Department of Natural Resource, Cornell University.

Nathaniel, S. P., Nwulu, N., and Bekun, F. (2021). Natural resource, globalization, urbanization, human capital, and environmental degradation in Latin American and Caribbean countries. *Environmental Science and Pollution Research*, 28(5), 6207-6221.

Nendel, C., Hu, Y., and Lakes, T. (2018). Land-use change and land degradation on the Mongolian Plateau from 1975 to 2015—A case study from Xilingol, China. *Land Degradation and Development*, 29(6), 1595-1606.

NİK.(2020). http://www.nik.com.tr/content_sistem_uydu.asp?id=1 Accessed Date: 20.12.2020

Niipele J, Chen J. (2019). The usefulness of alos-palsar dem data for drainage extraction in semi-arid environments in The Iishana sub-basin. J Hydrol Reg Stud 21:57–67. https://doi.org/10.1016/j.ejrh.2018.11.003.

Nitheshnirmal S, Thilagaraj P, Abdul Rahaman S, Jayakumar R. (2020). Erosion risk assessment through morphometric indices for prioritisation of Arjuna watershed using ALOS-PALSAR DEM. Earth Syst Environ Model. https://doi.org/10.1007/s40808-019-00578-y.

Polat, N. (2020). Mardin ilinde uzun yıllar yer yüzey sıcaklığı değişiminin incelenmesi, *Türkiye Uzaktan Algılama Dergisi* (TUZAL) – 2020; 2(1); 10-15.

Qin, Z.; Karnieli, A.; Berliner, P. (2001). A mono-window algorithm for retrieving land surface temperature from Landsat TM data and its application to the Israel-Egypt border region. *Int. J. Remote Sens*. 2001, 22, 3719–3746.

Selim, S. (2015). Planning Scheme of Köyceğiz-Dalyan Basin in the context of Green Infrastructure, Ege University, Institute of Science, 141 p, (unpublished PhD thesis)

Selim, S., Kaplan, A. (2016). Engaging Green Infrastructure Scheme into Watershed- and Urban-based Planning and Design Realms, Proceedings of the Fábos Conference on Landscape and Greenway Planning: Vol. 5: No.2 , Article 15.

Sharma, R., Pradhan, L., Kumari, M., and Bhattacharya, P. (2021). Assessing urban heat islands and thermal comfort in Noida City using geospatial technology. *Urban Climate*, 35, 100751.

Singh, R. L., and Singh, P. K. (2017). Global environmental problems. In Principles and Applications of Environmental Biotechnology for a Sustainable Future (pp. 13-41). *Springer*, Singapore.

Sobrino, J. A., Li, Z. L., Stoll, M. P., and Becker, F. (1996). Multi-channel and multi-angle algorithms for estimating sea and land surface temperature with ATSR data. *International Journal of Remote Sensing*, 17(11), 2089 – 2114.

Spronken-Smith, R. A., and Oke, T. R. (1998). The thermal regime of urban parks in two cities with different summer climates. *International journal of remote sensing*, 19(11), 2085-2104.

Sun, F., Mejia, A., Zeng, P., and Che, Y. (2019). Projecting meteorological, hydrological and agricultural droughts for the Yangtze River basin. *Science of the Total Environment*, 696, 134076.

Şekertekin, A., Kutoğlu, Ş., K., Kaya, Ş., Marangoz, A., M. (2015). Uydu Verileri ile Arazi Örtüsündeki Yer Yüzey Sıcaklığı Değişimlerinin Analizi: Zonguldak Örneği, Türkiye.

Tonyaloğlu, E., E. (2019). Kentleşmenin Kentsel Termal Çevre Üzerindeki Etkisinin Değerlendirilmesi, Efeler ve İncirliova (Aydın) Örneği, *Türkiye Peyzaj Araştırmaları Dergisi* 2019, 2:1, 1-13.

USGS.(2020).Landsat8.https://www.usgs.gov/coresciencesystems/nli/landsat/landsat8?qtscience_support_page_relatedcon=0#qtscience_support_page_related_con Accessed Date: 18.12.2020

USGS.(2021).Using the USGS Landsat Level-1 Data Product. https://www.usgs.gov/core-science-systems/nli/landsat/using-usgs-landsat-level-1-data-product. Accessed Date: 20.02.2021

Vikipedi.(2020).ManavgatNehri.https://tr.wikipedia.org/wiki/Manavgat_Nehri. Accessed Date: 18.12.2020.

Wang, J., Song, C., Reager, J. T., Yao, F., Famiglietti, J. S., Sheng, Y., and Wada, Y. (2018). Recent global decline in endorheic basin water storages. *Nature geoscience*, 11(12), 926-932.

Watkins, R., Palmer, J., and Kolokotroni, M. (2007). Increased temperature and intensification of the urban heat island: Implications for human comfort and urban design. *Built Environment*, 33(1), 85-96.

Zhang, Jinqu, Yunpeng Wang, Yan Li. (2006) 'A C++ program for retrieving land surface temperature from the data of Landsat TM/ETM+ band6', *Computers and geosciences*, 32: 1796-805.

CHAPTER 2

SMART CITIES IN THE CONTEXT OF GREEN INFRASTRUCTURE

Assist. Prof. Dr. Betül TÜLEK [1*]

Selin ERDOĞAN [2]

[1*] Çankırı Karatekin University, Faculty of Forestry, Department of Landscape Architecture, Çankırı, Turkey. E-mail: betultulek@karatekin.edu.tr ORCID ID: 0000-0002-6584-041X

[2] Çankırı Karatekin University, Faculty of Forestry, Department of Landscape Architecture, Çankırı, Turkey. E-mail: selinserdogan@gmail.com ORCID ID: 0000-0003-0234-6710

INTRODUCTION

Ecology is basically a science that examines the interaction of living things in an environment. It has drawn attention to biodiversity and protection of habitats. For these conservation strategies to be realized, open green areas should be included especially in the cities.

Plannings are supported by green infrastructure systems that connect nature and city in the most appropriate way and make both cities and nature livable for people (Firehock, 2010). Green infrastructure applications are made for all sizes areas. The success of the green infrastructure system depends on the effective connection established between different scales. The most important principle of green infrastructure is sustainability (Atmiş, 2016). Green infrastructure is a system based on nature (Firehock, 2010). The green infrastructure system is the study that has the broadest scope as a target that includes ecological network and green road studies (Semiz, 2016). It is an important factor that minimizes the damage to habitats and enables the natural life cycle to continue (Firehock, 2010). Green infrastructure is a comprehensive study. Therefore, it has been summarized with many different planning principles in the literature. These are multifunctionality, connectivity, integration, communication, social process and long-term strategy (Aslan and Yazıcı, 2016).

The use of the green infrastructure system and the integration of technology with the city constitute the smart city. The concept of smart city emerged as a result of the discussion that city and ecology have the same effect on human life. The common purpose of smart city and green infrastructure is the concept of sustainability. Green infrastructure systems provide the health of ecosystems by bringing fragmented areas together and provide more ecosystem services to the city and citizens by repairing degraded habitats (Atmiş, 2016).

The purpose of this study is to explain the green infrastructure system, which is based on nature, and the smart city system in cities that have become more livable by including this system, giving importance to ecosystem and sustainability. Green infrastructure is an advance system in the protection of natural areas, offers areas that improve human and nature relations when combined with the smart city system. In the results of these two concepts ensure that the quality of life, ecological, economical and sustainability impact, many projects and practices from Turkey and around the world are explained.

1. ECOLOGY AND LANDSCAPE ECOLOGY

"Ecology" is known as environmental science, examines the interactions of factors related to living things. The term ecology was defined by the German biologist Ernst Haeckel in 1866 as *'the interaction of living things with each other and their environment'*, While ecology was initially a very small branch of biology that examines the relations of plants and animals with their environment, it has emerged as a separate branch of science in parallel with the developing science and technology since the 1900s (Lawrance, 2003; Odum and Barrett, 2008).

The concept of landscape ecology was first used in 1939 by the German biogeographer Carl Troll (Turner et al., 2001; Deniz et al., 2006) and was considered a sub-branch of the discipline of ecology. Landscape ecology is a mosaic that forms a part of the earth and this mosaic is formed by the combination of many landscape elements (Turner et al., 2001).

Landscape ecology is to consider the relationship between the elements that make up the landscape. Within the scope of this concept, green infrastructure systems are defined within the framework of ensuring the protection of natural areas and their interconnection in order to ensure the continuity of biological diversity and prevent habitat fragmentation by preserving the integrity of the landscape.

2. GREEN INFRASTRUCTURE

Green infrastructure term was firstly used in a written governor's report on land conservation strategies in Florida in 1994. In this report, it is aimed to reflect the idea that natural ecosystem values are as important and equal as urban infrastructure components (Firehock, 2010). The main idea of the green infrastructure network is to ensure the continuity of biological diversity and to protect of natural areas for preventing habitat fragmentation (Semiz, 2016). According to Benedick and McMahon (2006), green infrastructure is a green space system that provides benefits for human beings by protecting natural ecosystem values and functions, this connectivity is provided by the center (core), connection / link (corridor), area (stain) (Figure 1).

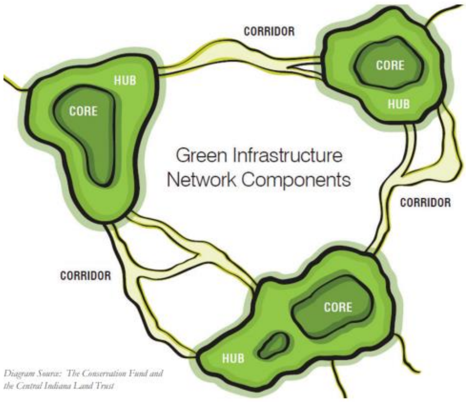


Figure 1. Green infrastructure system (Heartlands Conservancy, 2013)

Due to these components, green infrastructure systems are planned in a more usable way (Benedict and McMahon, 2006). In recent years, green infrastructure functions have been used for all ecology-based approaches, from green roofs to rainwater management systems.

3. SMART CITY CONCEPT

The urban approach, which emphasizes green, quality of life, governance and efficiency on the basis of environmental, managerial, economic sustainability and in which information and communication technologies are used as a tool, is called the smart city approach (Gürsoy, 2019). Beside overpopulation smart cities are the concept of dealing with the biggest problems in our society such as transportation, pollution, sustainability, safety, health and business life (Akdamar, 2017). In order for a city to be defined as a smart city, its components must be formed within the framework of sustainable information communication technologies and smart city design idea (Elvan, 2017).

Another subject, under the name of smart city studies, is ecological city approaches. Ecological city approach is like a heading that covers various concepts related to sustainability such as green building, low carbon, ecopolis, solar city (Köken, 2017).

In terms of ecological city approach, *urban planning* has some targets such as to reduce carbon emissions, to develop public transportation systems that do not harm the environment, to make close geographical areas accessible and walkable, to use clean and renewable energy resources, to create a participatory socio-cultural environment where education is accessible for everyone, to ensure ecological integrity with economic growth (Sınmaz, 2013).

The smart city concept is a system that adopts the concept of sustainability as a principle which has come into our lifes as an environmentally friendly application and keeping up with the developing technology. It basically reflects the idea of restructuring cities in a way that will provide maximum efficiency for nature and people. They are the settlements applied to use the land efficiently, increase the quality of life and support the local economic potential (Atmiş, 2016). In order for a city to be smart, its components should be formed within the framework of sustainable, compliance with information communication technologies and smart design (Elvan, 2017).

4. EXAMPLES OF SMART CITY FROM TURKEY AND AROUND THE WORLD

4.1.Amsterdam/The Netherlands

Technology is a key enabler in the fight against climate change, and the smart city strategy has been an opportunity for the city of Amsterdam to achieve its strategic goals faster. Therefore, policies regarding the use of information and communication technologies to improve environmental sustainability have continued steadily after the change of city management. It aims to regulate the energy consumption of Amsterdam residents within the framework of climate targets. It is also aimed to reduce CO_2 emissions by 40% in 2025 compared to 1990 for this purpose (Mora and Bolici, 2016).

As an important example in Amsterdam, The Edge Building can be given. According to BREEAM (BRE Environmental Assessment Method), the Edge is the world’s greenest office building, with an outstanding score of 98.36%, and it is a great example of a sustainable, innovative and smart structure. The main purpose of the building is to make employees feel comfortable in every environment they work in. For this reason, thanks to the app on their smartphones, it’s possible to set preferences about lights and temperature in the office, which will adjust automatically every time the person enter the room. Deloitte, as the building’s main tenant, wants to focus less on the task people has to do, and more on the community they build day after day, because that’s what makes a better workplace. They have implemented ‘hot-desking’, a system where no one has a dedicated desk and they instead choose where to work between a variety of different desk format around the building. This concept allows 2,500 workers to work while requiring half as many desks. The Edge Building's orientation is based on the path of the sun (Breem, 2021) (Figure 2).

Figure 2. The Edge Building (Living Map, 2021)

4.2.Barselona/Spain

Smart Cities perform modernization by using information and communication technologies on environment, mobility, housing, energy, communication and businesses in order to increase the quality of city life. In this context, Barcelona is one of the world leaders, which has many projects in the field of Smart City applications. Barcelona, which has carried out many studies and projects in this field, ranks first in Spain, 3rd in Europe and 10th in the world with its Smart City applications (Sevim et al., 2019).

Barcelona has determined 18 programs within the scope of smart city. These programs can be expressed as a new municipal network, urban platform, smart data, fourth generation wireless phone technology (4G) next generation data, smart lighting, self-sufficient energy, energy efficiency in buildings, smart water, zero emission in mobility, smart parking, smart transportation, urban transformation urban resilience, smart citizen, e-government and efficiency, cloud, Barcelona in my pocket, improved waste collection (Barcelona Smart City, 2014) (Figure 3).

Figure 3. Solar panels and selective waste collection (Barcelona Smart City, 2014)

4.3.Berlin/Germany

Berlin has been in a transformative process into a Smart City for few years. In this context, many projects are already being developed and implemented. The vision behind this is to shape Berlin into an intelligently networked, post-fossil and resilient city. To be a sustainably liveable and future-proof metropolis. 6 smart city topics are determined in this transformative process: *Smart Administration and Urban Society*: *Smart Living*: *Smart Economy*: *Smart Mobility*: *Smart Infrastructures*: *Public Safety* (Smart City Berlin, 2019) (Figure 4).

Figure 4. Berlin view (Smart City Berlin, 2019)

4.4.Stockholm/Sweden

Stockholm stands out especially with its smart applications for waste. Since smart bins in the city run on solar power and pack waste, they only need to be emptied four times a week. This means less garbage collection, lower costs and less emissions. The amount of waste is reduced and renewable by using solutions such as waste to energy systems where waste is recycled as district heating, electricity, biogas, bio fertilizers and materials. It is used as an environmentally safe energy source (Anonymous, 2020).

Stockholm adopted a new city plan. Making use of the assets that the city’s green spaces represent and developing parks and areas of countryside is an intrinsic part of the plan. As Stockholm’s population grows, initiatives are needed to improve the city’s green spaces, make them more accessible and add additional new parks. The plan contains more details of how to deploy Stockholm's blue green infrastructure, create a network of habitats for specific species and enhance urban ecosystem services (Oppla, 2021) (Figure 5).

Figure 5. Stockholm smart city (Smart City Sweden, 2021)

4.5. Vienna/Austria

Vienna has carried out important projects in the long term with the "Smart City Vienna (Smart City Wien)" application. Purpose in practice managed by local governments is to provide an equal living standard that covers all areas of business, entertainment and life and to increase the living standard by eliminating all kinds of problems in the city's social areas such as energy, infrastructure and mobility (Sevim et al., 2019) (Figure 6).

Figure 6. Vienna smart city view (Smart City Wien, 2021)

Vienna aims to increase the use of pedestrians, bicycles and public transportation by reducing the use of private vehicles in the context of smart city applications. Since these transportation plans are based on long-term investment in the city, they provide mobility to all citizens regardless of economic and social standards. It is also ecologically sustainable in terms of protecting social and natural resources and creating smart cities. The open space planning of Vienna is based on the continuous development of urban landscapes, the need for green space for daily life and the development of open and green spaces as an infrastructure element (Anonymous, 2017).

4.6.Konya/Turkey

Konya has focused especially on the transportation system within smart city application. In urban transportation, resources are used efficiently with smart technologies in both traffic management and public transportation and the quality of life is increased. With the Electronic

Control System (EDS), 63% reduction in fatal accidents has been achieved. Bicycle paths and the smart bike system have been actively used since 2008. In Konya's solid waste facility, the daily electricity need of an average of 26 thousand houses is met by electricity generation from methane gas. There are also many solar power plant in Konya as among the provinces with the highest solar energy potential in Turkey (Anonymous, 2019) (Figure 7).

Figure 7. Central Traffic Operating System - Bicycle Roads and Smart Bicycle System (Anonymous, 2019)

4.7.Antalya/Turkey

Antalya has come to the fore in smart city applications with waste recycling systems and energy panels in recent years. In this context, 1.24 MW solar panels have been installed on an area of 12 thousand m² on the Antalya Stadium with a capacity of 33 thousand people, which can meet the electrical energy needs of 575 residences. The facility can generate an average of 2 thousand MWs of electricity annually. With this facility, 1200 tons of CO_2 is prevented from being released into the nature annually, in other words, over 100 thousand trees are prevented from being cut down (Anonymous, 2019).

Within the scope of waste recycling, 3 thousand tons of domestic solid waste is separated into components per day in Integrated Solid Waste Disposal Facilities. Around 1250 tons of organic waste remaining as a result of this separation is converted into methane gas in the fermentation plant. Methane gas is transferred to the Energy Production Facility with a power of 25 MW and the electricity needs of 60 thousand houses (Anonymous, 2019) (Figure 8).

Figure 8. Electricity Generating Stadium - Solid Waste Integrated Assessment Recycling and Disposal Facilities (Anonymous, 2019)

5. CONCLUSION

Green infrastructure and smart city applications in the world and Turkey are to a new understanding, acceptance and began to be integrated into urban planning. Actually it is important to integrate green infrastructure and smart city applications into urban planning levels. In the urban planning process, from the highest scale to the urban scale, ecological approach-based planning and design principles should be established. This approach at all levels should provide ecological, economic and socio-cultural services.

Due to the significant effects of green infrastructure on urban life in Europe, the European Union developed a "Biodiversity Strategy" between 2011-2020 to stop biodiversity losses in Europe. According to this strategy; It is aimed to maintain and develop at least 15% of damaged ecosystems by establishing green infrastructure (European Commission, 2013). According to this target, green infrastructure functions have been started to used in the cities as green roofs, smart transportations, smart bike systems, rainwater management systems, energy efficiency buildings, waste recycling systems, energy panels, smart lighting, technology,etc. with smart city applications in Europe and around the world.

In Turkey, urban planning management activities, related policies, there is a need to integrate green infrastructure and smart city system. In this context, studies in many cities in Turkey, while the smart city strategies should be spread throughout the country, the scope should be improved and clarified. Reducing CO_2 emissions, collecting wastes for recycling, using renewable energies will significantly increase our quality of life. In the context of the green infrastructure system, we should be aware of the fact that our life has a great contribution to development and change in terms of both technological, economic and ecological aspects thanks to the sustainable smart cities that will cause the least damage to the environment in our life, and studies appropriate for this consciousness should be implemented.

REFERENCES

Akdamar, E. (2017). Akıllı Kent İdealine Ulaşmada Büyük Verinin Rolü. Uludağ Üniversitesi Sosyal Bilimler Enstitüsü, 10(2); 200-215.

Anonymous, (2017). Viyana 2025, https://www.surdurulebilir-sehirler.com/surdurulebilir-akilli-sehirler/ Accessed Date: 19.03.2021.

Anonymous, (2019). Akıllı Şehirler Beyaz Bülteni, Web: https://webdosya.csb.gov.tr/db/cbs/akillisehirler/, Accessed Date:: 04.07.2020.

Anonymous, (2020). Akıllı şehir nasıl gelişir, https://nscn.eu/Stockholm/SmartBins Accessed Date:: 19.03.2021.

Aslan, G., Yazıcı, K. (2016). Yeşil Altyapı Sistemlerinde Mevcut Uygulamalar. Türk Ziraat Yüksek Mühendisleri Birliği, syf;31-37.

Atmiş, E. (2016). Kentlere Soluk Aldıran Bir Sistem: Yeşil Altyapı, Süsbir Haber, Sayı 6, ss.64-66.

Barcelona Smart City, (2014). Ajuntament de Barcelona, http://www.localit.gr/wp content/uploads/2014/01/BarcelonaSmart-City_ENG_KEDE.pdf. 22.09.2016 Accessed Date::07.03.2021.

Benedict, M., McMahon. E. (2006). Green infrastructure: linking landscapes and communities.

Breem, (2021). The Edge, Amsterdam, https://www.breeam.com/case-studies/offices/theedgeamsterdam/#:~:text=The%20Edge%20is%20a%2040 %2C000,firm%20and%20main%20tenant%2C%20Deloitte Accessed Date: 26.03.2021.

Deniz, B., Küçükerbaş, E.V., Eşbah Tunçay, H. (2006). Peyzaj Ekolojisine Genel Bakış, *ADÜ Ziraat Fakültesi Dergisi* 2006; 3(2) : 5 – 18.

Elvan, L. (2017). Akıllı Şehirler: Lüks Değil, İhtiyaç. *İTÜ Vakfı Dergisi*, 77, 7-8.

European Commission, (2013). Building a Green Infrastructure for Europe. European Commission Building a Green Infrastructure for Europe. Luxembourg: Publications Office of the European Union 2013-24 pp. doi: 10.2779/54125. http://ec.europa.eu/environment/nature/ecosystems/docs/green_infrastructure _broc.pdf Accessed Date: 26.03.2021.

Firehock, K. (2010). Green infrastructure planning. University of Virginia, School of Architecture: The Green Infrastructure Center Inc. and the Department of Urban and Environmental Planning.

Gürsoy, O. (2019). Akıllı Kent Yaklaşımı ve Türkiye'deki Büyükşehirler İçin Uygulama İmkânları. Yüksek Lisans Tezi (basılmamış). 240, Ankara.

Heartlands Conservancy, (201). A Roadmap for Green Infrastructure, https://www.heartlandsconservancy.org/cmsb/uploads/green-infrastructureroadmap-final-small-size.pdf Accessed Date:: 26.03.2021.

Köken, K. (2017). Sürdürülebilir Kentsel Tasarım Kriterleri Açısından Kentsel Dönüşüm Projelerinin İncelenmesi. Uzmanlık Tezi, İller Bankası, Ankara.

Lawrence, R. J. (2003). Human ecology and its applications, Landscape and Urban Planning, Vol:65, Issue:1-2,pp:31-40.

Living Map, (2021). The greenest building in the world: The Edge. https://www.livingmap.com/the-edge/ Accessed Date: 26.03.2021.

Mora, L., Bolici, R. (2017). How to Become a Smart City: Learning from Amsterdam, Ed. Bısello, A., Vettorato, D., Stephens, R., Elısei, P., Smart and Sustainable Planning for Cities and Regions, Springer International Publishing, Switzerland.

Odum, E. P., Barrett, G.W. (2008). Ekoloji'nin Temelleri, Palme Yayıncılık, Çeviri Editörü: Prof. Dr. Kani Işık, Ankara.

OPPLA, (2021). Stockholm integrates urban green infrastructure and ecosystem services in the new city plan https://oppla.eu/stockholm-integrates-urban-green-infrastructure-and-ecosystem-services-new-city-plan Accessed Date: 18.03.2021.

Semiz, M. (2016). Yeşil Altyapı Sistemleri ve Kent Sürdürülebilirliği İlişkisi. Yüksek Lisans Tezi (Basılmamış).87s.,İstanbul.

Sınmaz, S. (2013). Yeni Gelişen Planlama Yaklaşımları Çerçevesinde Akıllı Yerleşme Kavramı Ve Temel İlkeleri. Yıldız Teknik Üniversitesi, 8(2); 76-86.

Smart City Berlin, (2019). Network Smart City Berlin, https://smart-city-berlin.de/en Accessed Date: 18.03.2021.

Smart City Sweden, (2021). Stockholm named world’s smartest city. https://smartcitysweden.com/stockholm-named-worlds-smartest-city/ Accessed Date: 26.03.2021.

Smart City Wien, (2021). Developing Energy Solutions For Everyday Urban Life. https://smartcity.wien.gv.at/en/aspern-smart-city-research Accessed Date: 26.03.2021.

Sevim, M.A., Kırcova, İ., Çuhadar, E. (2019). Yerel Yönetimlerde Akıllı Şehir Vizyonu: Şehir Yönetim Araçları ve Trendleri, *Strategic Public Management Journal,* Issue:9 , pp.109/126.

Turner, M.G., Gardner R.H., O'Neill R.V. (2001). Landscape Ecology in Theory and Practice: Pattern and Process, Springer-Verlag, NY.

CHAPTER 3

LANDSCAPE QUALITY OBJECTIVES IN TERMS OF URBAN IDENTITY: THE CASE OF ANTALYA AKSU

Assoc. Prof. Dr. Arzu ALTUNTAŞ [1*]

Prof. Dr. Veli ORTAÇEŞME [2]

[1*] Siirt University, Faculty of Agriculture, Department of Landscape Architecture, Siirt, Turkey. E-mail: arzualtuntas@yahoo.com.tr ORCID ID: 0000-0003-1258-3875
[2] Akdeniz University, Faculty of Architecture, Department of Landscape Architecture, Antalya, Turkey. E-mail: ortacesme@akdeniz.edu.tr ORCID ID: 0000-0003-1832-425X

INTRODUCTION

Landscape is formed by the combination of natural features of an area such as climate, relief, soil type, availability of water resources, and human-induced interventions such as agriculture, forestry, rural policies, cultural effects, economic pressures applied in the same space (Atalay, 2008).

Today, many researchers define the landscape as a socio-ecological system (Çetinkaya and Uzun, 2014). In other words, the definition of the landscape has taken on a new meaning in the form of people and their surroundings by separating from the field approach with visual / aesthetic features (Jensen and Murray, 2005).

The European Landscape Convention, which was adopted as a result of various national, regional and international studies, opened in signature in 2000 and entered into force in 2004 in Turkey, has been an important source of guidance for the signatory countries in defining the landscape with a common language, determining country landscapes at various scales and protecting, planning and managing these landscapes. The Convention encouraged the public, local and regional governments and other interested parties to define and implement landscape policies and to develop correct management systems. In addition, the Convention aims to integrate the landscape with the country's regional and urban planning policies as well as with cultural, environmental, agricultural, social and economic policies. Countries that have ratified and put into effect this Convention are obliged to fulfill the provisions of the

Convention. One of these obligations is the definition of landscapes and consequently, the determination of landscape quality objectives in terms of obtaining more applicable and realistic results in the stages of conservation, planning and management. According to the European Landscape Convention, the landscape is "an area formed as a result of the interaction and action of human and / or natural factors, as perceived by people" (Council of Europe, 2000). Landscape quality objectives mean “the expressing of the public's desire for the landscape lines of its environment by the competent public authorities for a particular landscape”. In other words, the expectations of the public, the opinions of the experts and the public policies regarding the landscape are the goals that the public decides on the development of the landscape. Consulting the opinion of the public in the decisions to be taken regarding the landscape is an important step in realizing more permanent implementations, creating and preserving the urban identity, increasing the life quality of the population and planning and managing the landscapes in a more qualified way.

1. RELATIONS OF URBAN IDENTITY AND LANDSCAPE

The city is a complex and multifaceted phenomenon. Cities are physical spaces that have shaped social and cultural changes and differ in demographic and economic terms throughout history. However, this space is not just a "place" formed by structures. Because the city is also a living organism, a social and cultural phenomenon in which social events take place and shape the relationship between people and its environment (Oğurlu, 2014).

Identity, on the other hand, is the set of features that distinguish a living thing or an object, an entity from others. From this point of view, all the features that distinguish one city from another constitute the identity of that city.

Urban identity is the perception formed by the physical, socio-economic, cultural and historical characteristics of a city (Oğurlu, 2014). According to another definition, urban identity is shaped by the physical, cultural, socio-economic, historical and formal characteristics of each city with different scales and interpretations. Urban identity is the meaningful integrity created by a great process extending from the past to the future that forms the way of life of the citizens and their life style (Topçu, 2011).

Cities are different in terms of nature, structures and people. They are not similar to each other and have various character. Everything that is dissimilatory and distinguishes a city from others is its identity (Oğurlu, 2014). Urban identity is the social, cultural and spatial story that the city shows its people. In other words, urban identity is the effect of urban components on people as a whole. The concept of urban identity has been discussed by various researchers over the artificial framework of the natural and built environment of the city since the 1970s.

In addition to their architectural textures, cities consist of natural, semi-natural and cultural landscapes that are presented to them by the geography in which they are settled, and which are preserved or newly created in line with the needs of those living in that city. Since the city is an area with intense human influence, at least one or all of these three landscape types exist in the city (Altuntaş and Şensoy, 2019).

Urban identity does not only consist of landscapes, of course. However, landscapes are both one of the elements that compose the city and a tool that emphasizes the city and urban identity, the concept of space, architectural texture and all elements of the city (Altuntaş and Şensoy, 2019).

2. MATERIAL AND METHOD

In this study, Aksu, one of the central districts of Antalya, was chosen as the sample area in determining the landscape quality objectives in terms of its contribution to the urban identity (Figure 1). Aksu district has both rural and urban character. Urban developments in the district are at the beginning stage. It also has extraordinary natural landscape elements such as Kurşunlu Waterfall and cultural / historical landscapes such as Perge Ancient City. EXPO 2016 Fairground is located in the district. Aksu district was chosen as the study area due to the presence of the Aksu River, which crosses the area and flows into the Mediterranean, and the presence of different sectors such as agriculture and tourism in the region.

Figure 1. The location of the research area

Aksu district is located in the central part of Antalya province, between 36 ° 56′ - 36 ° 94′ eastern longitudes and 30 ° 50′ - 30 ° 83′ northern latitudes. There are Muratpaşa, Kepez and Döşemealtı districts in the west and Serik district in the east. The district borders with Burdur in the north, and the Mediterranean in the south.

The surface area of the district is 45,648.7 ha. Settlements are generally seen as scattered throughout the district. There are tourism facilities on the coast. According to TÜİK (2015) data, the population of the district is 68,496 people.

Some important nationally and internationally recognized areas of Antalya province are located within the borders of Aksu. These include Perge Ancient City, Kurşunlu Waterfall Nature Park, Kemerağzı -

Kundu Culture and Tourism Protection and Development Area. EXPO 2016 Fairground, the first EXPO of Turkey, is also located within the boundaries of Aksu.

A five-step method was applied in the study. After the detailed analysis of the area, landscape change analysis, landscape character analysis and DPSIR (Drivers-Pressure-State-Impact-Response) analysis were performed. In addition, a survey was conducted in order to reveal the views and expectations of local people and experts regarding Aksu landscapes. For spatial analyses, 30-m terrestrial resolution Landsat satellite images of 1987, 2003 and 2015 were used. Based on the rectified images, the existing land cover / land use (LULC) was determined based on the European Union CORINE Land Classification System 2nd and 3rd levels and transferred to the Geographical Information Systems (GIS) after on-site controls. In addition, large soil groups and topographic structure data were used as a base. All data such as analyzes, field observations, literature reviews and face-to-face interviews obtained were evaluated with the help of ArcGIS 9.3, Erdas 9.3, R Software, MiniTab 13.0, SPSS 15.0 and Microsoft Office Excel 2007 softwares. Thus, Aksu district landscape quality objectives have been formulated under different sectors / elements. One of these elements is the city image and urban identity.

3. RESULTS

3.1. Landscapes of Aksu

Aksu district has a very important place for Antalya with its natural and cultural values. The district, which has great positive effects on the economy of Antalya in terms of agricultural production, also contributes to the tourism sector with its Kemerağzı-Kundu Culture and Tourism Protection and Development Zone (Figure 2) and alternative tourism opportunities. Kurşunlu Waterfall Natural Park (Figure 3), Perge Ancient City (Figure 4), EXPO 2016 Fairground (Figure 5) are other important areas, especially in terms of urban identity and tourism.

Figure 2. Kemerağzı - Kundu Culture and Tourism Protection and Development Zone (Oertel, 2012)

Figure 3.Kurşunlu Waterfall Nature Park (Original, 2016)

Figure 4. Perge Ancient City (Original, 2016)

Figure 5.EXPO 2016 Fairground (Original 2016)

When the LULC between 1987 and 2015 is examined in the study area, an increase of 783% is observed in the urban texture in this 28-year period. In this process, discontinuous urban texture and areas with little or no vegetation have increased. Terrestrial waters, mixed agricultural areas and forests have decreased. The development of tourism in the region, the increase of the urban texture due to the increase in population, the fires that occur especially in the mountainous-hilly areas in the north of the region, the protection of Kurşunlu Waterfall Nature Park and Belek Tourism Region, the construction of the EXPO 2016 Fairground are the main reasons for this change (Table 1).

Table 1. The amount of LULC between 1987-2015

Land Cover Class (1987)*	Land Cover Class (2015)* UT	DUT	SMQ	MAA	F	ALV	TW	Total (ha)
UT	149,2	0,0	0,0	0,0	0,0	0,0	0,0	**149,2**
DUT	0,0	172,7	0,0	0,0	0,0	0,0	0,0	**172,7**
MAA	1.168,2	189	0,0	27.469,6	416,8	487,1	0,0	**29.730,7**
F	0,0	125,6	130,1	439,3	10.216,7	483,6	0,0	**11.395,3**
ALV	0,0	155,4	0,0	110,4	353,3	2.295,2	0,0	**2.914,3**
TW	0,0	0,0	0,0	196,2	24,9	47,2	1.018,2	**1.286,5**
Total (ha)	**1.317,4**	**642,7**	**130,1**	**28.215,5**	**11.011,7**	**3.313,1**	**1.018,2**	**45.648,70**

UT: Urban Texture; **DUT:** Discontinuous Urban Texture; **SMQ:** Stone / Mining Quarries; **MAA:** Mixed Agricultural Areas; **F:** Forests; **ALV:** Areas with Low Vegetation; **TW:** Terrestrial Waters

In the determination of the landscape character areas and types of Aksu district, pre-classification was made first. In the pre-classification, topography, large soil groups and land cover / land use data were used as a base. Accordingly, 20 landscape character types were found in the district. As a result of the statistical analysis and field observations, it was determined that these character types define 3 landscape character areas (Figure 6) (Altuntaş and Ortaçeşme, 2017).

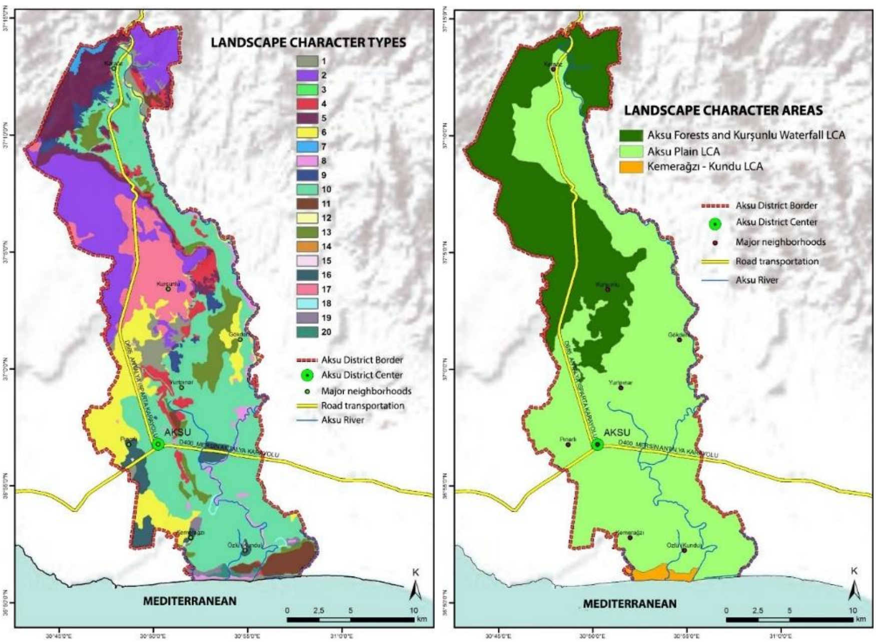


Figure 6. Landscape character types (on the left) and landscape character areas (on the right) in Aksu

DPSIR analysis is based on monitoring the landscape feature, measuring the changes in the landscape condition and its quality, and defining the types of pressures that affect the situation (Atalay, 2008). Factors that can be defined as driving forces in Aksu district were determined and the pressures caused by these factors were examined. Impact and response steps of DPSIR analysis are evaluated together as a single step under the heading of responses. In the DPSIR analysis conducted for the Aksu district, the driving forces were defined as agriculture, rapid urbanization and population growth, tourism and transportation / infrastructure. The DPSIR analysis concluded that the driving forces defined for Aksu district will increase the need for land

and use of natural resources, transformation of forests and agricultural areas, increase in construction activities, increase in unplanned housing and human pressure. Therefore, it has been concluded that ecosystems will be damaged, there will be loss of species in flora and fauna, and various environmental problems will arise.

A questionnaire consisting of 20 questions was applied to the local people. In this survey, questions such as their liked and disliked characteristics in Aksu district, the problems they experienced, how they evaluate Aksu and Aksu landscapes were asked. In addition, their views on how some natural events and human activities affect the quality of the landscape (positive, negative or ineffective) were requested. The responses obtained show that natural areas / forests, Kurşunlu Waterfall, Aksu River, Kundu Hotels Area, Perge Ancient City and EXPO 2016 Fairground were identified as entities with positive effects by the questionnaire participants. However, they evaluated the structural elements in the district as entities with negative effects. The industrial facilities in the district, the condition of the buildings in the rural areas and the city, the advertisement board, signage, antenna, air conditioner, etc. were stated as negative factors. In addition, occasional floods in the district was also evaluated as a negative factor (Altuntaş and Ortaçeşme, 2017).

The experts were asked about the landscape characteristics that may be effective in determining the landscape quality goals and the situations that may threaten the quality of the landscape. In addition, questions were asked in order to get their thoughts on Aksu landscapes. Again, the expert group was asked for their views on how some natural events and human activities affect the quality of the landscape. Experts said that natural areas / forests, Kurşunlu Waterfall, Aksu River and Perge Ancient City are positive for Aksu landscapes. However, they think that all other factors affect them negatively. They also gave negative answers about the Kundu Hotels Area and the EXPO 2016 Fairground (Altuntaş and Ortaçeşme, 2017).

3.2. Quality Objectives for Aksu Landscapes

Despite its values, Aksu district does not receive enough attention and this is the main barrier before its development. For a sustainable development of the district, they propose the better promotion of the natural and cultural features of Aksu landscapes. Although the local people think that Kurşunlu Waterfall Nature Park, Perge Ancient City, EXPO 2016 Fairground and Kemerağzı-Kundu Culture and Tourism Protection and Development Area positively affect Aksu landscapes, they think that these areas do not contribute enough to the development of the district.

Experts think that the destruction and deterioration of local values pose a threat to the quality of the landscape. For this reason, it is extremely important to introduce Aksu with all its features and to protect its values in order to increase its image.

Landscape quality objectives regarding the image and identity of Aksu are given in Table 2, based on the analyses, interviews and literature information made within the scope of the study.

Table 2. Landscape quality objectives regarding the image and identity of Aksu district

LANDSCAPE QUALITY OBJECTIVES	SOURCE OF OBJECTIVES		
	SR	FO	LR/FI
The necessary arrangements should be made by researching alternative tourism opportunities of the area.		✓	✓
A suitable city park and city square should be built in the district center.		✓	✓
Various viewing terraces should be built where appropriate and Aksu landscapes should be monitored.		✓	
Green corridors should be established in the area, especially in the district center.		✓	
The district is very insufficient and weak in terms of social areas. Places where people and visitors can socialize such as shopping malls and sports areas must be built. Cleaning and maintenance of existing ones should be carried out regularly.	✓	✓	
New parks and playgrounds should be built in suitable areas. The maintenance of existing ones should be carried out regularly.	✓	✓	
Promotional posters related to the values of the district should be developed. Intangible cultural assets should be investigated.		✓	✓
The image of the city should be strengthened with appropriate urban furniture.		✓	
The existing green areas should be maintained regularly.		✓	
The sustainability of EXPO 2016 Fairground should be ensured. This area should be maintained.		✓	✓
Tours that will enable visitors staying in the hotels area to visit Aksu should be organized.		✓	

SR: Survey results; **FO:** Field observations; **LR/FI:** Literature reviews / face-to-face interviews

4. CONCLUSION

Turkey signed the European Landscape Convention and made it a part of its domestic law. The commitments are now mandatory legal rules for the country. The Convention aims to protect and develop environmental values, one of the most important components of the landscape, in order to increase the quality of life (Erdem and Coşkun, 2009). The Convention is based on the balance and harmony of the relationship between social needs, economic activities and ecological development in achieving sustainable development. In this context, it has brought a different perspective by addressing European landscapes as a whole, redefining "landscape" and the concepts related to landscape for its protection, management and planning (Kap, 2006).

The answer to the question about what the landscape quality objectives are is both very simple and very complex: “What kind of landscape do we want?” Landscape quality objectives, one of the foundations of the European Landscape Convention, are a key reference point in making spatial and sectoral policies for institutions and society to move towards a country with better landscapes that have a positive impact on the populations’ quality of life. Therefore, landscape quality objectives have a strategic position. It is generally accepted as a new tool in landscape planning and management, which requires a great sensitivity to landscape in all segments of society (Observatori del Paisatge, 2011). In addition to this, landscapes and quality objectives related to these landscapes are one of the main actors that play a role in the development and protection of cities' identities.

The ability of cities to protect their identity and develop in accordance with their identities depends on not neglecting the ecological, social and cultural dimensions of development. The growth of cities on the way to development should be carried out in consideration of the urban identity. This requires the urban identity to be considered as an important planning parameter. In addition, the inhabitants of the city, who are extremely active in the formation of a city's identity, and the natural values of the city, should be able to direct the planning strategies of the city (Altuntaş and Şensoy, 2019). Landscape quality targets guide the determination of these strategies. The identity of the city is formed over a long period time. The city's geographical character, cultural level, architecture, landscape, traditions and lifestyle shape the city. Although the areas that give identity to the city are handled not individually, but as a whole, it should not be forgotten that the integrity of identity consists of individual areas. For this reason, it is extremely important to protect and develop each element and value separately and to protect each detail in order not to lose the city's identity (Oğurlu, 2014).

Aksu is a district in the east of Antalya city, which still preserves its natural and agricultural character to a great extent. The district hosts natural and cultural elements of national and international importance such as Kurşunlu Waterfall Natural Park, Perge Ancient City and EXPO 2016 Fairground. However, the population of the district is increasing rapidly and a rapid tourism development is observed in the part of the district on the Mediterranean coast. For this reason, it is important to protect the quality of the district landscapes.

When the locations and structures of the cities from past to present are examined, urban areas have always been located in fertile lands in landscape. For this reason, cities are home to different species of plants and animals by accommodating various habitats. However, the effects of urbanization and the physical change of the local landscape adversely affect the habitats of plant and animal species. Changes in land use patterns, loss and fragmentation of natural areas, loss of local and natural vegetation, and spread of exotic species are some of the factors that negatively affect the habitats of plant and animal species. In addition, ignoring factors such as biological diversity in landscape planning and design processes followed by local administrations and municipalities has led to an increase in problems. The fact that the society is not conscious about local biodiversity habitats will also cause an increase in problems related to biodiversity in the future (Uslu and Shakouri, 2015). For this reason, comprehensive studies must be carried out by experts on the ecological values of Aksu.

The promotion of Aksu with all the values it possesses is of great importance both for the economy of the district and for the economy of Antalya. All necessary studies should be carried out with experts in this field and the district should reach the level of sustainable development it deserves as soon as possible.

REFERENCES

Altuntaş, A., Ortaçeşme, V. (2017). Peyzaj Kalite Hedeflerinin Yerel Ölçekte Belirlenmesi: Antalya Aksu Örneği. Mediterranean Agricultural Sciences, 30(2), 121-131.

Altuntaş, A., Şensoy, N. (2019). An Evaluation on the Impact of Landscape on Urban Identity. Kentsel Araştırmalar – 2 Editör: Doç Dr. Yaşar Bahri ERGEN, Dr. Öğr. Üyesi Mustafa ERGEN. Gece Akademi, Basım sayısı:1, Sayfa Sayısı 372, ISBN:978-625-7002-25- 7, İngilizce(Bilimsel Kitap).

Atalay, A. (2008). Gökçeada İçin Bir Kaynak Yönetim Modelinin Geliştirilmesi. Doktora tezi. Ankara Üniversitesi, Fen Bilimleri Enstitüsü, Peyzaj Mimarlığı Anabilim Dalı, 120 s., Ankara.

Council of Europe (2000). European Landscape Convention. Floransa.

Çetinkaya, G., Uzun, O. (2014). Peyzaj Planlama. Birsen Yayınevi, 219 s., İstanbul.

Erdem, N., Coşkun, A.A. (2009). Avrupa Peyzaj Sözleşmesi Hükümlerinin Türk Planlama Mevzuatına Uyumluluk Analizi. *İstanbul Üniversitesi Orman Fakültesi Dergisi*, Seri B, Cilt 59, Sayı 2, 64 – 78 s., İstanbul.

Jensen, K., Murray, F. (2005). Intellectual Property Landscape of the Human Genome. Science 310(5746): 239-40.

Kap, S.D. (2006). Avrupa Peyzaj Sözleşmesi Kapsamında Yeşil Alan Kullanımı; İstanbul Boğaziçi Ön Görünüm Bölgesi Örneği. Mimar Sinan Güzel Sanatlar Üniversitesi Fen Bilimleri Enstitüsü, Şehir ve Bölge Planlama Anabilim Dalı, Kentsel Tasarım Yüksek Lisans Tezi, 180 s., İstanbul.

Observatori Del Paisatge (2011). Landscape Quality Objectives for Catalonia. http://www.catpaisatge.net/eng/objectius.php

Oertel, B. (2012). Kemerağzı-Kundu Turizm Gelişim Bölgesi görüntüsü. http://www.panoramio.com/photo/81044412?source=wapiandreferrer=kh.google.com

Oğurlu İ. (2014). Çevre – Kent İmajı – Kent Kimliği – Kent Kültürü Etkileşimlerine Bir Bakış. *İstanbul Ticaret Üniversitesi Fen Bilimleri Dergisi*, Yıl: 13, Sayı: 26, İstanbul, 275 – 293 s.

Topçu, K.D. (2011). Kent Kimliği Üzerine Bir Araştırma: Konya Örneği. *Uluslararası İnsan Bilimleri Dergisi*, Cilt:8, Sayı:2, s. 1052.

TÜİK (2015). Aksu İlçesi Nüfus İstatistikleri. https://biruni.tuik.gov.tr/medas/?kn=95andlocale=tr

Uslu, A., Shakouri, N. (2015). Kentsel Peyzajda Biyoçeşitliliğin Korunması ve Geliştirilmesinde Toplum Farkındalığı. Yerel Peyzajlar ve Koruma Sorunları 15-17 Ekim 2015 – I. Ulusal Ankara Üniversitesi Peyzaj Mimarlığı Kongresi, Bildiriler Kitabı, 251-257 s., Ankara.

CHAPTER 4

DESIGN CRITERIA FOR INCLUSIVE PUBLIC SPACES IN NEIGHBORHOOD

Dr. Pelin ŞAHİN KÖRMEÇLİ *

* Çankırı Karatekin University, Faculty of Forestry, Department of Landscape Architecture, Çankırı, Turkey. E-mail:pelinsahin@karatekin.edu.tr ORCID ID: 0000-0003-4772-8202

INTRODUCTION

Public spaces have a vital role in meeting individuals' social relations, health and well-being. Nowadays the rising urbanization leads to many challenges such as infectious diseases, so people need open and green spaces where they can relax and spend time in city. Public spaces like parks, streets, squares and playgrounds located in open and green areas are important for individuals to benefit from the outdoor. Carr et. al. (1992) define public spaces as open and accessible places where people go for group or individual activities. Determining the design criteria of livable public spaces in cities is important in terms of managing the problems that will arise in cities in the future. Neighborhoods, which are a physical design tool in cities, are easily accessible and social interaction areas for residents. It is necessary to develop inclusive design criteria at the neighborhood unit in order to create sustainable cities by creating spaces that are usable for everyone.

Inclusive design provides that all individuals in urban open and green spaces use equally. This approach is defined as the design that emerges when accessibility standards are included in the design process instead of adding them to later, and by foreseeing equal use for each user, protecting social equality and human dignity, and supporting social interaction (Kaymaz, 2015). The philosophy of this approach is to make cities livable by affecting the use of public space and to develop the design that will bring together in the society in all living spaces. Inclusive design not only improves the quality of life but also contributes to social civilization and is useful to promote the harmonious development of society (Liu and Hou, 2010). Inclusive design idea, which offers solutions for everyone, should be taken into consideration in cities.

Neighborhoods, where people can easily access when they leave their homes, can be used as models for the practicing of inclusive design. The aim of this study is to determine inclusive design criteria at the neighborhood unit. The fact that the neighborhoods used as a physical design tool include different typological public spaces is a model for evaluation. In this context, multiple inclusive design parameters, which should be evaluated at the neighborhood scale, have been examined in line with the literature researches, different city practices and design guides samples. At the end of research, the inclusive design criteria for the public space are classified with the strategies and practices of neighborhood scale.

1. THE NEIGHBORHOOD UNIT

The concept of neighborhood was first introduced by Clarence Perry at the beginning of the 20th century to solve the transportation problem in residence and city centers (Eisner et. al., 1993). Neighborhood is an area that has sociological, cultural and economic dimensions rather than being defined as a physical area (Johnson, 2002). Neighborhoods, seen as living organism cells, are defined as the smallest building blocks of the spatial hierarchy, having a certain administrative boundary and geographical location, and a sociological space where communication between local people is important (Kanlı, 2016). Neighborhood unit is described as physical design tool that provides residents opportunities to interact with those within its boundaries (Lloyd Lawhon, 2009). Perry (1929) organized neighborhood unit design within scope of the following suggestions:

- School should be located in the center of the neighborhood and children should be able to walk 400 meters to the center without using a major arterial street. The neighborhood size should be in approximately 160 acres at a density of ten units per acre with between 5,000 to 9,000 residents.
- A wider use of school facilities should be implemented for neighborhood meetings and activities, and a large playground should be created around the buildings for use by all community. Local shopping areas should be restricted main entrance of neighborhood thus excluding traffic for commercial uses.
- Arterial streets should be placed around the neighborhood perimeter, so that they defines the neighborhood and eliminates unwanted traffic congestion.
- Curvilinear street design should be used in internal street for aesthetic purposes, safety of pedestrians and discourage unwanted traffic.
- It should be dedicated at least 10 percent of the neighborhood land area to parks and open space for play or people interaction.

Neighborhoods are accessible and living spaces where social integration provided in community. The physical and administrative boundaries of the neighborhood unit depend on the size of the population it contains and may vary according to different societies and periods, social boundaries are determined by neighborly relations (Altun, 2010). In order to determine the boundaries of the neighborhoods, the physical population size and the access distance are considered. It is not only the population size that provides the physical characteristics, but the walkability distance and social relations are effective in the formation of the neighborhood area. An adult person can walk 800 meters under conditions where the slope of the topography is not challenging, according to this value, the size of the neighborhood is 20-50 ha and the distance and time relationship around the neighborhood is given in Figure 1 (Akın and Erkan, 2012).

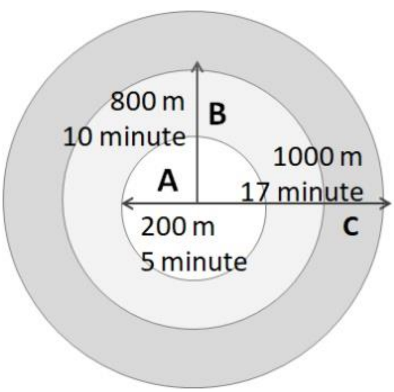


Figure 1. Distance and time relationship in neighborhood (Akın and Erkan, 2012). (modified by author)

A. Residential environment B. Neighborhood C. City

Many neighborhoods practices designed to solve social problems and design sustainable environments with urbanization. Radburn settlement, one of the examples of inclusive neighborhoods with easy access, parks, playgrounds and bicycle paths, consists of single-family housing groups and culde-sac streets, considering the principle of pedestrian and vehicle road separation (Eisner et. al, 1993). Großsiedlung Britz, which is listed as a world heritage site as an example of other inclusive neighborhoods, is one of the designs created by the arrangement of the use of the public space in the housing units designed in horseshoe shape that allow people of different income groups to live (Figure 2).

Figure 2. Grossiedlung Britz, Germany (Unesco, 2018)

In order to solve the problems in the cities, it is necessary to design inclusive neighborhood within the framework of similar examples, considering natural and cultural factors. Today, the problem of neighborhoods is that they lack of public spaces that provide daily needs, spaces that allow trade, education, culture and social interaction. In this context, it is important to determine the design criteria of public spaces to provide functionality.

2. DESIGN CRITERIA FOR INCLUSIVE PUBLIC SPACES

Many countries develop design guidelines for practices of sustainable cities. The neighborhood practices of countries that are good in terms of planning and design in different geographies selected as models in urban design guides strategies are ***mixed-use development, pedestrian and transit-oriented design, sustainable land use, integrated transport system*** (ÇŞB, 2016). The inclusive design criteria, which are the evaluation tools of these practices, were examined in the research.

2. 1 Mixed-use Development

Public spaces provide services to community groups with different characteristics. Individual's age, gender, education level, senses, technological changes, and cultural differences can play a role in shaping the space (Evcil, 2017). In order to increase the use of space in cities, there should be social diversity in public spaces (Lambert, 2005). Spaces where individuals of different ages, genders and abilities (disabled, pregnant etc.) will be together are among the design criteria. Encourages social interaction and coexistence of mixed residents with well-designed urban fabric and functional public spaces (Schreiber and Carius, 2016). Public spaces such as children's playgrounds, squares, and parks in neighborhoods should allow the use of all individuals. Serçev Children's Playground is practice of providing public space for different abilities in Turkey (Figure 3).

Figure 3. Inclusive playgrounds, Serçev Park, Ankara, Turkey

According to the researches (Gehl 1987, Rivlin 1994, Whyte 2000), increased activities in the public space supports social interaction. The variety of activities designed for different groups is one of the factors affecting the use of public spaces (Hesham, 2015). Social activities created according to the characteristics of public spaces increase the people interaction and quality of life (Nasution and Zahrah, 2012). Crossan et. al. (2015) points out that community gardens have a positive effect on the mental health and well-being of individuals by increasing physical activity. Designing community gardens and activity areas that support social integration in the neighborhoods are among the criteria that support the inclusive design (Figure 4).

Figure 4. a. Community garden, Holland.

b. Activity areas, Kiev, Ukraine

2.2 Pedestrian and Transit-oriented Design

One of the criteria in evaluating livability in urban areas is walkability (Lynch, 1981, Katz, 1994, Montgomery 1998). People are not happy to walk more than 10 minutes to meet their daily needs (Lambert, 2005). According to Time Saver Accessibility Standards, 400-800 meters, which takes between 5 and 10 minutes, are shown as walking distance. (Harris and Dines, 1998). Kazmierczak (2013) stated that the access distance of the city dwellers to public spaces in terms of walking and the attractiveness of the space increase social integration. Open and green areas within walking distance of the residential area offer the opportunity to use for everyone. The other criterion of urban walkability is urban furniture (Akkar Ercan and Belge, 2017). It is known that urban furniture, which are examined in terms of public space quality, increase social interaction (Whyte, 2000). The design of urban furniture for different abilities person sustain accessibility in urban areas (Figure 5).

Figure 5. Inclusive urban furniture

a. Information sign, Ukraine b. Public toilet, Ukraine

c. Bike stops, Vienna, d. Sitting area, Vienna

Walkability requires safety and comfortable conditions for pedestrian such as the use of roads, land use pattern. Walkable public spaces are effective in reducing traffic density by providing easy movement. Low-speed vehicle circulation in public spaces increases the orientation of people to the outdoors and creates livable environments (Gehl, 1987). Street designs where people with low vehicle density can walk comfortably are highly accessible in cities. Some roads are closed to traffic in order to socialize people with traffic regulations in Kiev (Figure 6).

Figure 6. Traffic calming intervention for socializing, Kiev, Ukraine

In addition to the traffic calming regulations, technical standards regarding the street cross-section design criteria should be developed in urban (Figure 7). Compliance with accepted universal standards such as UN, ADA, NACTO regarding the design of street elements (lighting, pavement etc.) is essential for everyone's use.

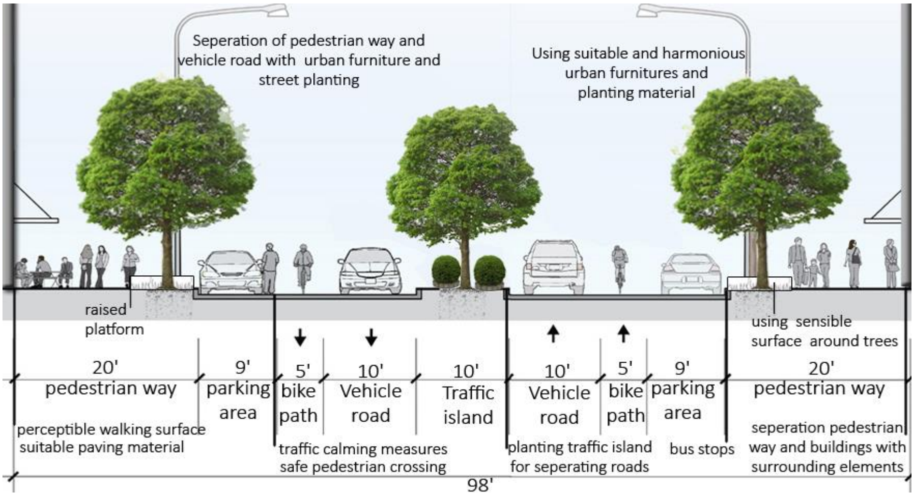
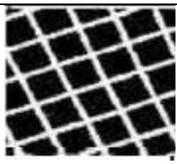
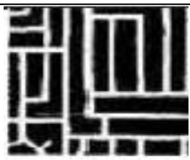
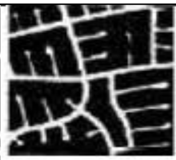


Figure 7. Street cross-section design, New York (modified by author) (NACTO, 2012)

The street form created by the roads in public spaces determines the use of space. Street forms are evaluated with the network system formed by the roads in urban areas. Street patterns are classified in five ways in land use; gridiron, fragmented parallel, warped parallel, loops on a stick, lollipops o a stick (Southworth and Own, 1993) (Table 1). Among the street models, gridiron roads are highly connected and have more potential in terms of walkability than others (Lambert, 2005).

Table 1. Street patterns (Southworth and Own, 1993)

				
a. Gridiron	b. Fragmented parallel	c.Warped parallel	d.Loops and lollipops	e.Lollipops on a Stick
-It is strongly interconnected ,expandable and creates the most walkable neighborhood. -It offers the shortest trip and the largest number of route choices.	-It reduces the number of access points. -This pattern diminishing value of pedestrian access.	-It makes user orientation more confusing in neighborhoods -The transition to an automobile subdivision becomes more pronounced in this pattern.	-It has lots of short streets but creating quiet and safe area. -This pattern is proving undesirable for both the driver and pedestrian.	-It's intersections, route choices, and access points are very limited. -It maximizes the number of house lots on short culde-sac streets.

In addition to the street patterns, the number of intersections of the roads showing their connectivity is one of the parameters that should be evaluated in walkabilty. When the connectivity of networks is high, the walkability and accessibility are also in high level (Southworth, 2005). Özbil et. al (2015) stated that the more intersections the streets that support walking are, the higher the accessibility in that area. Connectivity value is found by dividing the number of streets by the number of intersection points, and this value should be greater than 1.4 (Litman, 2012).

2.3 Sustainable Land Use

The presence of active green spaces that can be used by the neighborhood population in cities is a factor to be taken into account in terms of using space. The World Health Organization (WHO) stated that the amount of green space per person in a city should be at least 9 m^2 regardless of the population, but the ideal is 10-15 m^2. Spatial Plans and Publications Regulations in Turkey (2014) formed in the amount of 10 m^2 green area per person is required by norms. As a result of the epidemic problems in many countries, people need to be in the green area. Green areas should be planned in a way that people can easily reach and this should be complied with in the amount of green areas per person considering standards. The qualities and functions of green spaces, where all individuals actively coexist, are also important. Selection of suitable plant species, plant location and planting composition are the criteria that should be evaluated in creating an inclusive planting design (ÖZİ, 2011). In addition to green spaces in cities, there is a need for open spaces in different typologies where people can be together. The diversity of public spaces of a city, it's being open to everyone, accessible and walkable, serving different individuals of the society makes that city and public spaces livable (Dumbaugh, 2005). Public spaces in different typologies such as parks pedestrianized streets and squares in Vienna offer people the opportunity to meet (Figure 8).

Figure 8. Public spaces in different typologies, Vienna

(a. Park, b. Street, c. Square)

2.4. Integrated Transport System

The integrated transportation system with pedestrian, vehicles and bike paths together and the pedestrian priority design approach are among the urban design guides and sustainable design strategies of many countries (ÇŞB, 2016). There is a need for a holistic and comprehensive transportation and pedestrian oriented strategy plan where non-motorized transportation vehicles, public transportation and vehicles are developed together, public transportation stops, parking lots, railway stations and bus terminals are integrated with the pedestrian transportation system in cities (Southworth, 2005). As long as it can create a balance between vehicle and pedestrian use in urban space, it creates fair, equitable and inclusive environments for different social segments (Akkar Ercan and Belge, 2017). The integrated transportation system with walkable streets in Bratislava, where pedestrians, vehicles and public transportation design together, create inclusive areas (Figure 9).

Figure 9. Integrated transport system, Bratislava, Slovakia

3. CONCLUSION

There is a need for sustainable design approaches in cities due to the problems that have arisen as a result of rapid population growth in cities recently. In order to ensure a sustainable urban development process, compact city models that provide high density residential areas, mixed land uses and less energy consumption should be created in cities. It is necessary to support social development by increasing the variety of public spaces and walkable areas in the neighborhoods. Similar to the ideal green city practices of countries, ecological city-centered solutions should be developed by creating green spaces. It is also important to the land use effectively, to provide easy access, increase the pedestrian and public spaces. In addition, working and living areas are designed together; different kinds of people should be brought together in activity areas.

Designing inclusive public spaces increases the livability of cities. Neighborhood units, which are within walking distance and have many public spaces, should be considered as physical design tools. Many countries develop design guides, which include strategies, goals, or practices in country, region, city and neighborhood scale. In this context, the inclusive design criteria that can serve as a basis for design guidelines were created by examining the neighborhood-scale parameters in the research. As a result of the evaluations of literature research, inclusive public space design criteria are given with the based on strategies and practices in Table 2.

Table 2. Design criteria for inclusive public space

Strategies of inclusive design	Practices of inclusive design	Criteria for inclusive design in neighborhood
1. Mixed use development	**a. Inclusive public spaces**	Public space where individuals of different gender, age, education level and abilities can be together
	b. Social areas	Activity areas and community gardens for meeting
2. Pedestrian and transit-oriented design	**a. Walkable areas**	Open and green areas within walking distance to the residence
	b. Pedestrian friendly streets	Traffic calming interventions in streets
	c. Mixed-use street design	Street design elements in line with universal standards
	d. Accessible street pattern	Street form and network connectivity
	e. Inclusive urban furniture	Design of urban furniture for different abilities person
3. Sustainable land use	**a. Active green areas**	Standards for green area per capita according to population density
	b. Public space diversity	Public space in different typology
	c. Inclusive planting design	Planting design in line with standards
4. Integrated transport system	**a. Public transport based areas**	Transportation system where pedestrians, public transportation vehicles and bicycle paths are together

Developing these design criteria obtained from the research in the different cities local governments will contribute to social cohesion in communities by increasing the sustainability of the cities. The research will also support the development of the design criteria in different area and the establishment of a monitoring and evaluating public spaces in cities.

REFERENCES

ADA, (2010).Standards for Accessible Design. Department of Justice, http://www.ada.gov/regs2010/2010ADAStandards/2010ADAStandards_prt.pdf, Accessed Date: 29.03.2021.

Akın, O., Erkan, N. (2012). Kentsel Dönüşüm ve Mahalle Yenileme Olgusu Bağlamında Planlama-Tasarım İlkeleri. *Şehir Düşünce Merkezi*, (6), 119-151.

Akkar Ercan, M., Belge, Z. S. (2017). Daha Yaşanabilir Kentler için Mikro Ölçek Bir Yürünebilirlik Modeli. METU *Journal of the Faculty of Architecture*, 34(1), 231-265.

Altun, D. A. (2010). Kapalı Konut Siteleri ve 'Mahalle' Kavramı. *İdealkent dergisi*, 1(2), 216-244.

Carr, S., Francis, M., Rivlin, L. and Stone, A. (1992). *Public Space*, Cambridge: Cambridge University Press.

Crossan, J., Shaw, D., Cumbers, A., McMaster, R. (2015). *Glasgow's Community Gardens: Sustainable Communities of Care*. University of Glosgow, 26, Scotland, UK.

ÇŞB, (2016). *Kentsel Tasarım Rehberleri.* Mimar Sinan Güzel Sanatlar Üniversitesi. Kentsel Tasarım Uygulama ve Araştırma Merkezi. T. C. Çevre ve Şehircilik Bakanlığı Yayını, İstanbul: İncekara Matbacılık 3 cilt.

Dumbaugh, E. (2005). Safe Streets, Livable Streets. *Journal of the American Planning Association*, 71(3), 283-300.

Eisner, S., Gallion, A, Eisner, S. (1993). The Urban Pattern, Canada: John Wiley and Sons.

Evcil, A. N. (2017). Esenler Cumhuriyet Meydanı'nın Daha Kapsayıcı Daha Canlı Daha Yaşanabilir Olması için Bazı Öneriler. İstanbul: *Şehir Düşünce Merkezi Şehir Yayınları,* Yayın No: 13.

Gehl, J. (1987). *Life between Buildings: Using Public Space*, Copenhagen: Arkitektens Forlag.

Harris, C. W., Dines, N. T. (1998). *Time-saver standards for landscape architecure*. New York: McGraw-Hill Publishing.

Hesham, E. O. (2015) Small Town Community Social Interaction in Public Spaces. *PhD Thesis*, Malaysia: Faculty of Built Environment Universiti Teknologi.

Johnson, D. L. (2002). Origin of the Neighbourhood Unit. *Planning Perspectives*, 17(3), 227-245.

Kanlı, İ. B. (2016). Sürdürülebilir Gelişmeyi Sağlamada Stratejik Bir Araç: Mahalle Kooperatifleri. *Çağdaş Yerel Yönetimler Dergisi*, 25(3), 1-34.

Kaymaz, M. K. (2015). Eğitim Yapılarında Bedensel Engellilere Yönelik Engelsiz Tasarım. *Selçuk-Teknik Dergisi*, 14(2), 238-250.

Katz, P., Scully, V. J., Bressi, T. W. (1994). *The new urbanism: Toward an architecture of community* (Vol. 10). New York: McGraw-Hill.

Kaźmierczak, A. (2013). The Contribution of Local Parks to Neighborhood Social Ties. *Landscape and Urban Planning*, 109(1), 31-44.

Lambert, K., (2005). Critical Evaluation of Livability in Garisson Woods, *A master thesis*. University of Calgary, Faculty of Environmental Design, Canada.

Litman, T. (2012). Evaluating non-motorized transportation benefits and costs. Guide to Valuing Walking and Cycling Improvements and Encouragement Programs Victoria Transort Policy Institute (VTPI).

Liu, Y., Hou, Y. (2010). Green and Harmony, Idea Study Based on the Sustainable Universal Design. *Conference on Environmental Science and Information Application Technology*, ESIAT 2010, 17-18 July, Vol: 1 Wuhan, China, pp.289-291.

Lloyd Lawhon, L. (2009). The neighborhood unit: physical design or physical determinism? *Journal of Planning History*, 8(2), 111-132.

Lynch, K. (1981). *A Theory of Good City Form,* Cambridge: MIT Press.

Montgomery, J. (1998). Making a city: Urbanity, vitality and urban design. *Journal of urban design*, 3(1), 93-116.

NACTO, (2012). Urban Street Design Guide, New York: *National Association of City Transportation Officials.*

Nasution, A. D., Zahrah, W. (2012). Public Open Space Privatization and Quality of Life, Case Study Merdeka Square Medan. *Procedia-Social and Behavioral Sciences*, 36, 466-475.

Özbil, A. Yeşiltepe, D., Argın, G. (2015). Modeling walkability: The effects of street design, street-network configuration and land-use on pedestrian movement. *A|Z ITU Journal of the Faculty of Architecture*, (12)3, 189-207

ÖZİ, (2011). Yerel Yönetimler için Ulaşılabilirlik Temel Bilgiler Teknik El Kitabı, H. Kaplan, Ü. Yüksel, A.B. Gültekin, C. Güngör, N. Karasu, M. Çavuş (Eds), Ankara: T.C. Başbakanlık Özürlüler İdaresi Başkanlığı Yayınları, General Publication No:49, ISBN: 978-975-19-4679-9, 139.

Perry, C. A. (1929). The Neighborhood unit-a scheme of arrangement for the family-life community, regional survey of New York and its environments. New York: *Neighborhood and Community Planning*, *Committee of Regional Plan of New York and Its Environs.*

Rivlin, L.G. (1994). *Public Spaces and Public Life İn Urban Areas*, The Urban Experience: A People-Environment Perspective, London: Taylor and Francis Group (289-296).

Schreiber F., Carius A. (2016). *The Inclusive City: Urban Planning for Diversity and Social Cohesion.* In *State of the World.* Washington, DC: Island Press.

Southworth, M., Owns, P. M. (1993). Evolving Metropolis: Studies of Community, Neighborhood, and Street Form at the Urban Edge, *Journal of the American Planning Association*, 59(3), 87-217.

Southworth, M. (2005). Designing the Walkable City. *Journal of Urban Planning and Development-Asce*, 131(4), 246-257.

UN, (2004). Accessibility for the Disabled a Design Manual for a Barrier Free Environment, United Nations, Department of Economic and Social Affairs, Division for Social Policy and Development. https://www.un.org/esa/socdev/enable/designm/ Date accessed: 28.03.2020.

UNESCO, (2008). Housing Estates in the Berlin Modern Style. Nomination for Inscription on the UNESCO World Heritage List. Berlin. https://whc.unesco.org/uploads/nominations/1 239.pdf, Accessed Date: 22.03.2021.

Whyte, W. H. (2000). *The Social Life of Small Urban Spaces, Common Ground? Readings and Reflections on Public Space*, New York: Routledge.

CHAPTER 5

SPATIAL ACCESSIBILITY TO URBAN GREEN SPACES WITHIN THE SCOPE OF NATIONAL LEGISLATION; CASE OF SERİK, ANTALYA

Assoc. Prof. Dr. Rifat OLGUN [1*]

Assist. Prof. Dr. Ceren SELİM[2]

[1*] Akdeniz University, Vocational School of Serik Gülsün-Süleyman Süral, Department of Park and Horticulture, Antalya, Turkey. E-mail:rifatolgun@akdeniz.edu.tr ORCID ID: 0000-0002-5396-057X

[2] Akdeniz University, Faculty of Architecture, Department of Landscape Architecture, Antalya, Turkey. E-mail:cerenselim@akdeniz.edu.tr ORCID ID: 0000-0001-7694-2449

INTRODUCTION

Cities are areas whose boundaries and power of self-governance are determined by laws that emerge after societies have settled down (Alacadağlı, 2018). Cities are spatial formations / complex structures that have social, economic, cultural and spatial components, where the complexity of social life is concentrated and formed within this chaos (Sennet, 2002; Oktay, 2007). A city is a living organism that is never static, but is constantly evolving depending on many factors (Yaylı, 2012).

Cities included in a certain system integrity are a complex structure that integrates natural, economic, social and ecological environments within a certain period and space (Zhang et al., 2011; Zou et al., 2012; Kanta and Zechman, 2014; Zhou et al., 2015). In cities with this complex structure, the increasing density of buildings and unplanned development due to industrialization and rapid population growth cause the disconnection of cities with rural areas, the damage to biodiversity, the rapid deterioration of the existing open green areas and the natural structure. It also causes cities to become socially, culturally and biologically inadequate environments for human life (Kuter, 2007; Das et al., 2013; Çınar et al., 2015; Karakaya Aytin and Korkut, 2015; Ardahanlıoğlu et al., 2017; Şalap Ayça et al., 2018).

The world urbanization rate was calculated as 29% in 1950, 37.4% in 1975 and 47.1% in 2000 (United Nations, 2004; Demir and Çabuk, 2010). Today, more than half of the world's population (54%), consisting of societies that are increasingly globalized and interacting with each other, live in urban areas. In this context, it is expected that this increase in the urban population will continue and will be around 60% in 2030 (United Nations, 2014; Gupta et al., 2016).

Depending on these developments in the world, especially in Turkey after 1950 it showed a large increase in urban population with migration from rural to urban areas (Keloğlu and Karabacak, 2020). According to the data of Turkish Statistical Institute 2020, 93% of the country's population lives in cities, while 7% lives in villages.

In this context, urban green areas are crucial in reducing the problems that occur in cities with the effect of urbanization. Urban green spaces have an important effect in reducing the pressure of rapidly increasing urbanization on individuals and increasing the quality of life of individuals living in the city (Vlad and Brătăşanu, 2011; Henderson, 2013; Selim et al., 2014).

Green areas in cities have positive impacts on the social bonding of individuals living in the city, on the welfare, health and quality of life of the individuals (Frumkin, 2013; Hartig et al., 2014; Markevych et al., 2014; Taylor and Hochuli, 2015; Van den Berg et al., 2015; Taylor and Hochuli, 2017; Çınar et al., 2016).

Green areas, which offer opportunities such as outdoor physical activities, strengthening social bonds, and a comfortable and peaceful life, are an important environmental factor in determining the general state of health of individuals living in cities. Another important function of urban green spaces is to display cultural and personal diversity and to emphasize personal opinion. Urban parks, which are defined urban gaps, are places and symbols that bring people together and help to establish communication between the individual and the society (Özdemir, 2009). An Increasing number of researches in recent years show the relationships between green spaces and different health problems such as lack of physical activity, overweight, obesity, and stress (Health Council of the Netherlands and Dutch Advisory Council for Research on Spatial Planning, 2004; Croucher et al., 2007; Bowler et al., 2010; Lachowycz and Jones, 2011; Lee and Maheswaran, 2011; Van Den Berg et al., 2015). Researches reveal that there is a positive relationship between green spaces and physical activity and that green spaces encourage physical activity (Sugiyama et al., 2008; Schipperijn et al., 2010).

Researches show that there is a positive relationship between green spaces and the reduction of stress (Van Den Berg et al., 2010; Thompson et al., 2012) and stress-based psychosocial and psychological diseases (Adevi and Lieberg, 2012; Francis et al., 2012; Adevi and Martensson, 2013). In addition, in some researches, positive significant relationships were found between green spaces and decreased depression, anxiety (Bodin and Hartig, 2003; Maas et al., 2009), anger, and aggression (Ulrich, 1981; Kuo and Sullivan, 2001; Bodin and Hartig, 2003). Researches also show that there is a positive relationship between green spaces and physiological well-being (sense of humor, effective body functioning, pulse rate, heart rate, blood pressure, etc.) (Herzog and Strevey, 2008; Park et al., 2008; Akpınar and Cankurt, 2015).

There are laws and regulations for the planning of cities that differ according to countries and each country determines according to its own internal dynamics. There are legal regulations for the planning of cities in Turkey (Olgun and Yılmaz, 2017). Today, the legal situation regarding the planning of urban green areas is the development law numbered 3194 published in the official newspaper numbered 18749 on May 9, 1985, and the "Regulation on the Amendment of the Regulation on the Principles of Making Development Plan and Amendments" published in the official newspaper numbered 23804 on September 2, 1999.

One of the most important factors affecting the accessibility of natural areas and urban green areas is the distance to these areas. The distance or proximity of green areas to individuals is a factor that determines the use of these areas. Studies have shown that the frequency of use of green spaces decreases with increasing distance (Coombes et al., 2010; Irvine et al., 2013; Sugiyama et al., 2014; Ekkel and de Vries, 2017). In this context, in order to benefit from the opportunities and advantages of urban green spaces, these areas must first be accessible. For this reason, one of the issues related to the use and potential benefits of urban green spaces is the evaluation of their geographical accessibility (Reyes et al., 2014; Olgun, 2018).

Many studies on the accessibility of green spaces have been conducted by researchers from different parts of the world, and certain standards have been tried to be determined according to the types and sizes of green spaces (Van Herzele and Wiedemann, 2003; Oh and Jeong, 2007; Gupta et al., 2016; Selim and Karakuş, 2016).

In Turkey, there is a Spatial Plans Construction Regulation published in the official newspaper numbered 29030 on 14 June 2014 for the accessibility of active green spaces in legal legislation. In the 12th article of this regulation, it is stated that "In the development plans, children's park, playground, open district sports area can be planned in the service impact area that must be reached on foot by taking into account the distance of 500 meters".

The aim of the research is to determine the accessibility (impact areas) of the parks planned in the Serik city implementary development plan and to develop suggestions for regions and neighbourhoods that are outside of their impact areas.

1. MATERIAL AND METHOD

Serik, determined as a research area, is a district of Antalya province located within the borders of the Mediterranean Region. It is located between 36°55'1.34" latitude and 31° 6'16.99" longitude of Turkey. The research area is adjacent to Aksu district in the west direction, Manavgat district in the east direction, Burdur and Isparta provinces in the north direction, and it is bordered by the Mediterranean in the South (Figure 1). Mediterranean climate prevails in the district. Seasonally, summers are dry and hot, winters are mild and rainy (Serik Municipality, 2021). According to the data of Turkish Statistical Institute 2020, the population of the city is 130,589.

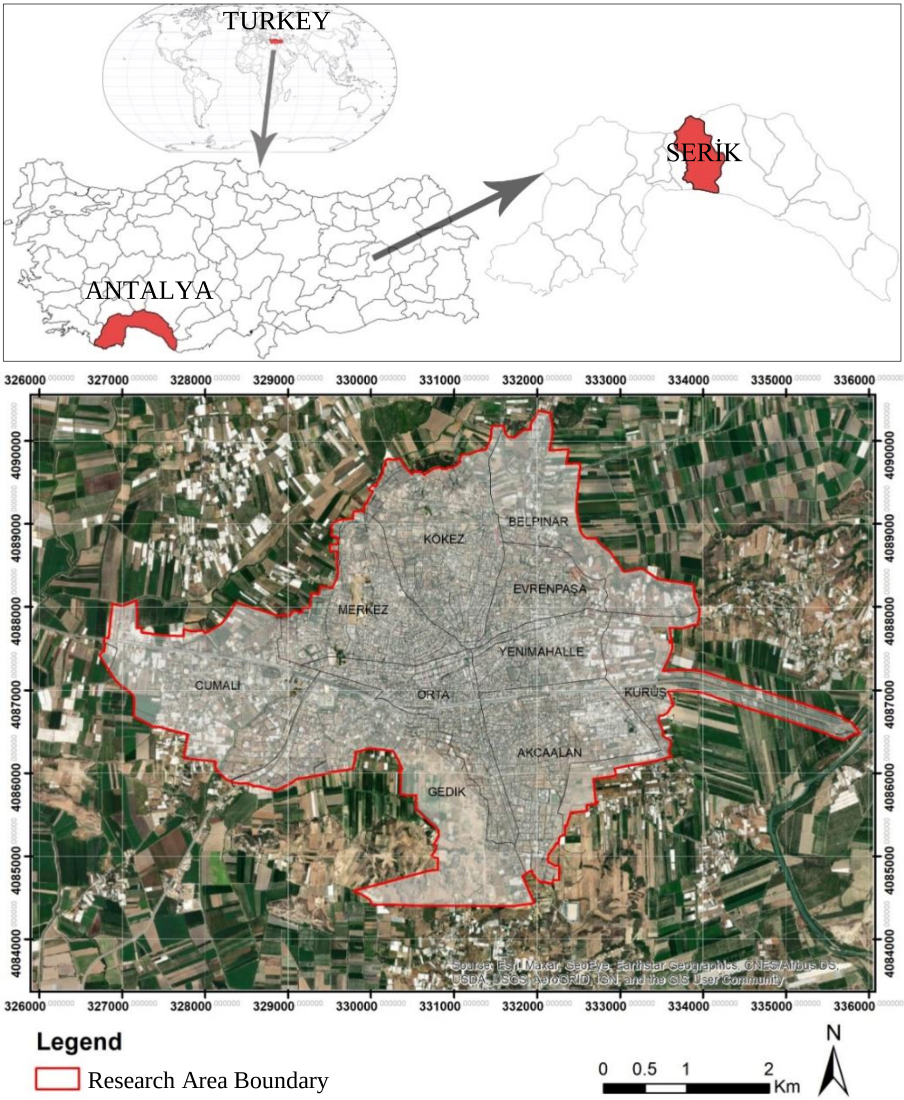


Figure 1. Location of the research area

The main materials of the research are the neighbourhoods, development plans and planned park areas within the borders of Serik municipality. In addition, the literature (thesis, book, article, project, etc.) studies on the research area, green areas and accessibility of green areas also constitute the materials of the research.

The implementary development plan (1/1000 scale) for the research area was obtained from Serik Municipality. First of all, the development plans obtained were arranged on a neighbourhood scale in the NetCAD software. And the data for evaluating the development plan and neighbourhood boundaries and planned green areas for the research were classified. Then the raster and vector data were transferred to the ArcGIS software and the data were placed in world coordinates according to the WGS_1984_UTM_Zone_36N coordinate system. These data were arranged on the scale of the neighbourhood and the database required for the research was created. And, data entries in accordance with the purpose of the research were applied to this database. At the last stage, accessibility maps were created by applying buffer analysis in order to determine the accessibility (impact areas) of the parks according to the data obtained.

In determining the accessibility of green areas, the Spatial Plans Construction Regulation published in the official gazette numbered 29030 on 14 June 2014 was taken into consideration. In the second paragraph of article 12 of the fourth part of this regulation, it is stated that "In the development plans, children's park, playground, open district sports area can be planned in the service impact area that must be reached on foot by taking into account the distance of 500 meters". Within the scope of the regulation, the accessibility of the parks planned in the implementary development plan have been evaluated by considering the 500 m distance.

2. RESULTS

Serik was established in two separate locations, "Sillyon" near Yanköy and Aspendos in Belkıs, depending on the Kingdom of Bergama in the 2nd century AD. And, it has been under the influence of different civilizations since its foundation. When the Seljuks came to Antalya in 1207, they first settled in Serik, then it was ruled by the Ottomans. During the Republic period, Serik became a district in 1926 (Babazade, 2020; Serik Municipality, 2021) (Figure 2).

Figure 2. General view from Sillyon and Aspendos region (Anonymous, 2021; Antalya Museum Directorate, 2021)

Serik region stands out with coastal sand dunes in the coastal part, pine nut forests which are seen in a very limited area in Antalya and the Mediterranean, coastal settlements, agricultural areas and intensive tourism facilities. There are rural settlements, agricultural and forestland in the backshore and mountains (Kanabakan, 2013). There is a compact settlement in the city centre.

According to the implementary development plan, there are 10 neighbourhoods within the boundaries of the research area. These neighbourhoods are Cumalı, Merkez, Kokez. Belpınar, Orta, Gedik, Evrenpaşa, Yenimahalle, Akcaalan and Kürüş Neighbourhoods. When the research area was evaluated in terms of the existence of green areas planned, it was determined that there were more intense green areas in the northern part of the study area. Especially in Merkez and Kökez Neighbourhood's, the planned green areas are denser than other neighbourhoods. However, it is seen that a small number of green areas are planned in Yenimahalle and Orta Neighbourhoods located in the city centre (Figure 3).

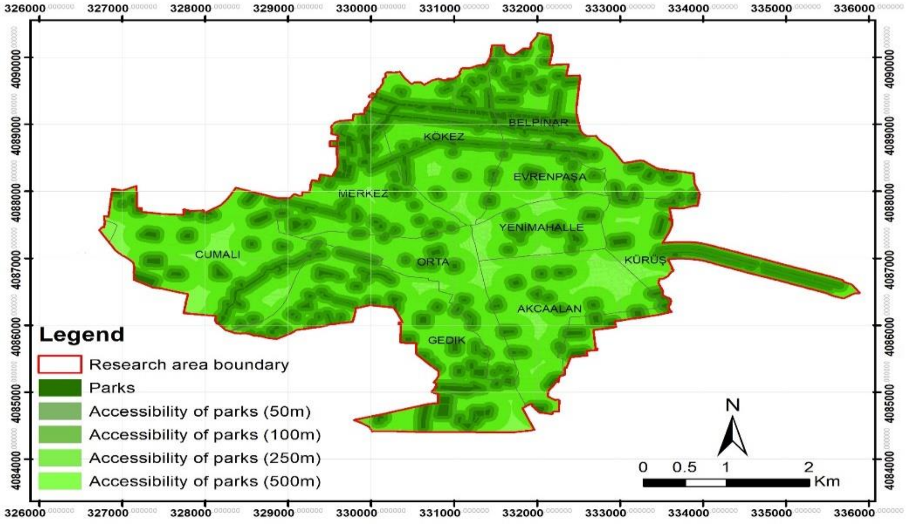


Figure 3. The presence of park areas in the development plan and prioritized accessibility of parks

The accessibility of the parks in the research area has been evaluated by considering the Spatial Plans Construction Regulation published in the official newspaper numbered 29030. In this context, the entire research area remains within the impact area of the parks planned in the development plan. Thus, individuals living within the boundaries of the research area can provide access parks within 500 m distance. In addition, the accessibility of the parks has been prioritized according to the distance values of 50, 100 and 250 m. According to the classification made in this context, Belpınar, Gedik, Kökez and Merkez Neighbourhoods are the neighbourhoods that remain densely within the 50-100 meter impact area of the parks in terms of accessibility. For this reason, the proximity of the park areas in Belkıs and Kökez Neighbourhoods provide a green corridor effect.

3. CONCLUCION

One of the most important components of sustainable urban planning is the homogeneous distribution of urban green spaces in urban plans and their accessibility. For this reason, studies on the distribution and accessibility of urban green areas in cities were carried out in Turkey as performed in different cities of the world by many researchers. The results obtained from the studies differ according to the region where the research was conducted and the green space planning strategies of the region. In this context, Abercrombie et al. (2008), Landry and Chakraborty (2009), Dahmann et al. (2010), Leslie et al. (2010), Sister et al. (2010), Johnson-Gaither (2011), Jennings et al. (2012), Wolch et al. (2014) revealed that the distribution of urban green spaces is mostly disproportionate and that access to green spaces is over time a matter of environmental justice. In addition, Tabassum and Sharmin (2013), Reyes et al. (2014) and So (2016) conducted research on the distribution of urban green spaces and their accessibility. In these researches, they have reached the conclusion that green areas do not show a homogeneous distribution in cities and that green areas do not serve the whole city (Olgun, 2018). Similar results have been obtained in studies conducted in Turkey. In this context, as a result of the researches carried out by Yenice (2012), Gökyer and Bilgili (2014), Manavoğlu and Ortaçeşme (2015), Önen (2015) and Olgun (2018), the parks in the study areas show a heterogeneous distribution in the whole city form and It has been determined that not all individuals in the city have access to parks. The park areas planned in the master plans of Serik city, which is a research area, can be accessed from all parts of the research area. This situation will contribute to the outdoor physical activities of the individuals living in the city and will be effective in strengthening the social bond between individuals. In addition, this will contribute to the increase of the aesthetic value of the city and to make it attractive.

REFERENCES

Abercrombie, L. C., Sallis, J., Conway, T., Frank, L. D., Saelens, B. E. and Chapman, J. E. (2008). Income and Racial Disparities in Access to Public Parks and Private Recreation Facilities. *American Journal of Preventative Medicine*, 34(1): 9-15.

Adevi, A. A. and Lieberg, M. (2012). Stress Rehabilitation Through Garden Therapy A Caregiver Perspective on Factors Considered Most Essential to The Recovery Process. Urban Forestry and Urban Greening, 11: 51-58.

Adevi, A. A. and Martensson, F. (2013). Stress Rehabilitation Through Garden Therapy: The garden As A Place in The Recovery From Stress. Urban Forestry and Urban Greening, 12: 230-237.

Akpınar, A. and Cankurt, M. (2015). Assessing The Association Between The Amount of Green Space Per Capita and Mortality in Turkey. *Adnan Menderes University Journal of Agriculture Faculty*, 12(2): 101-107.

Alacadağlı, E. (2018). Effects of Public Improvement Planning to Urbanization; An Evaluation of Bayburt and Ankara Examples. Turkish Studies, 13(18): 93-115.

Anonymous, (2021). Sillyon Ancient City. https://antalya.com.tr/listing/silyon-antik-kentis (accessed date: 06.04.2021).

Antalya Museum Directorate, (2021). Aspendos-Antalya. https://www.kulturportali.gov.tr (accessed date: 06.04.2021).

Ardahanlıoğlu, Z. B., Karakuş, N., Selim, S., Çınar, İ. and Türkkan, H.R. (2017). Kentsel Tarım Alanlarının Cbs Teknolojileri Kullanılarak Dağılımının Değerlendirilmesi: Seydikemer Örneği". Fen, Matematik, Mühendislik ve Doğa Bilimleri Araştırmaları 2017. (Ed: Çiftçi, N., Kara, Y., Yalçınkaya, İ., Şahin, M. and Ağaçayak, T.), Çizgi Kitabevi Yayınları, ss.198-205.

Babazade, R. (2020). The Place of Gastronomy Culture in Tourism: The Investigation With The Tourists Who Visit Serik. MSc Thesis, Muğla Sıtkı Koçman University, Muğla.

Bodin, M. and Hartig, T. (2003). Does The Outdoor Environment Matter For Psychological Restoration Gained Through Running?. Psychology of Sport and Exercise, 4: 141-153.

Bowler, D. E., Buyung-Ali, L. M., Knight, T. M., Pullin, A. S. (2010). A systematic review of evidence for the added benefits to health of exposure to natural environments. Bmc Public Health, 10: 1-10.

Coombes, E., Jones, A. P. and Hillsdon, M. (2010). The Relationship of Physical Activity and Overweight to Objectively Measured Green Space Accessibility and Use. Social Science and Medicine, 70(6): 816-822.

Croucher, K., Myers, L. and Bretherton, J. (2007). The Links Between Greenspace and Health: A Critical Literature Review. University of York, York, 61 p.

Çınar, İ., Çiçek, İ., Karakus, N. and Ardahanlioglu, Z. R. (2016). Thermal Comfort Assessment of the Urban Mediterranean Climate in Fethiye, Southwest Anatolia, Turkey. International *Journal of Advances in Science, Engineeringand Technology,* 4(3): 46-51.

Çınar, İ., Karakuş, N., Ardahanlıoğlu, Z. R. and Selim, S. (2015). Evaluation of the Open and Green Spaces in the Aspect of Urban Ecosystems:Case of Fethiye City, Turkey. Environment and Ecology at the Beginning of 21st Century. (Ed: Efe, R., Bizzarri, C., Cürebal, İ., and Nyusupova, G.N.) ST. Kliment Ohridski University Press, pp.398-410.

Dahmann, N., Wolch, J., Joassart-Marcelli, P., Reynolds, K. and Jerrett, M. (2010). The Active City? Disparities in Provision of Urban Public Recreation Resources. Healthand Place, 16(3): 431-445.

Das, S., Bhattacharya, A. and Mali, S. (2013). Study On Urban Land Suitability Assessment Using Remote Sensing and GIS: A Case Study Of Khairagarh, In Chhattisgarh. *International Journal of Computer Applications*, 74(10): 20-26.

Demir, K. and Çabuk, S. (2010). The Population Growht of Metropolitan Cities in Turkey. *Journal of the Institute of Social Sciences*, 28(1): 193-215.

Ekkel, E. D. and De Vries, S. (2017). Nearby Green Space and Human Health: Evaluating Accessibility Metrics. Landscape and Urban Planning, 157: 214-220.

Francis, J., Wood, L. J., Knuiman, M. and Giles-Corti, B. (2012). Quality or Quantity? Exploring The Relationship Between Public Open Space Attributes and Mental Health in Perth, Western Australia. Social Science and Medicine, 74: 1570-1577.

Frumkin, H. (2013). The Evidence of Nature and The Nature of Evidence. *American Journal of Preventive Medicine*, 44(2): 196-197.

Gökyer, E. and Bilgili, B. C. (2014). A Research on Assessment of Accessibility of Green Areas: The Case of Bartın Province. *SDU Faculty of Forestry Journal*, 15: 140-147.

Gupta, K., Roy, A., Luthra, K., Maithani, S. and Mahavir (2016). Gis Based Analysis For Assessing The Accessibility At Hierarchical Levels of Urban Green Spaces. Urban Forestry and Urban Greening, 18: 198-211.

Hartig, T., Mitchell, R., De Vries, S. and Frumkin, H. (2014). Nature and Health. Annual Review of Public Health, 35: 207-228.

Health Council of the Netherlands and Dutch Advısory Council for Research on Spatial Planning (2004). Nature and Health. The Influence of Nature on Social, Psychological and Physical Well-Being. The Hague: Health Council of the Netherlands and Rmno, 112 p.

Henderson, J. C. (2013). Urban Parks and Green Spaces in Singapore. Managing Leisure, 18(3): 213-225.

Herzog, T. R. and Strevey, S. (2008). Contact With Nature, Sense of Humor, and Psychological Well-Being. Environment and Behavior, 40(6): 747-776.

Irvine, K. N., Warber, S. L., Devine-Wright, P. and Gaston, K. J. (2013). Understanding Urban Green Space As A Health Resource: A Qualitative Comparison of Visit Motivation and Derived Effects Among Park Users in Sheffield, UK. *International Journal of Environmental Research and Public Health*, 10: 417-442.

Jennings, V., Johnson-Gaither, C. and Gragg, R. S. (2012). Promoting Environmental Justice Through Urban Green Space Access: A Synopsis. Environmental Justice, 5(1): 1-7.

Johnson-Gaither, C. (2011). Latino Park Access: Examining Environmental Equity in A New Destination County in The South. *Journal of Park and Recreation Administration,* 29(4): 37-52.

Kanabakan, A. (2013). Examination of The Landscape Toponimi in Antalya-Serik Region. MSc Thesis, Akdeniz University, Antalya.

Kanta, L. and Zechman, E. (2014). Complex Adaptive Systems Framework To Assess Supply-Side and Demand-Side Management For Urban *Water Resources. Journal of Water Resources Planning and Management*, 140(1): 75-85.

Karakaya Aytin, B. and Korkut, A. B. (2015). Investigation Open and Green Areas Existence in The Boundaries of Protected Area of Edirne City. *Journal of Tekirdag Agricultural Faculty,* 12(3): 100-108.

Keloğlu, E. and Karabacak, K. (2020). Assessment of Open Green Areas in Keçiören District of Ankara Province. *The Journal of the Faculty of Languages and History-Geography*, 60(2): 776-802.

Kuo, F. E. and Sullivan, W. C. (2001). Aggression and Violence in The Inner City: Impacts of Environment Via Mental Fatigue. Environment and Behavior, 33: 543-571.

Kuter, N. (2007). The evaluation of historical city center of Çankırı within the presence of its open and green spaces in the frame of urban landscape design. PhD Thesis, Ankara University, Ankara.

Lachowycz, K. and Jones, A. P. (2011). Greenspace and Obesity: A Systematic Review of The Evidence. Obesity Reviews, 12(5): 183-189.

Landry, S. M. and Chakraborty, J. (2009). Street Trees and Equity: Evaluating the Spatial Distribution of An Urban Amenity. Environment and Planning, 41: 2651-2670.

Lee, A. C. K. and Maheswaran, R. (2011). The Health Benefits of Urban Green Spaces: A Review of The Evidence. *Journal of Public Health*, 33(2): 212-222.

Leslie, E., Cerin, E. and Kremer, P. (2010). Perceived Neighborhood Environment and Park Use As Mediators of The Effect of Area Socio-Economic Status on Walking Behaviors. *Journal of Physical Activity and Health*, 7(6): 802-810.

Maas, J., Verheij, R. A., De Vries, S., Spreeuwenberg, P., Schellevis F. G. and Groenewegen P. P. (2009). Morbidity Is Related To A Green Living Environment. *Journal of Epidemiol Community Health*, 63: 967-973.

Manavoğlu, E. and Ortaçeşme, V. (2015). A Multi Criteria Analysis of The Green Spaces in Antalya and The Development of Planning Strategies. *Akdeniz University Journal of Agriculture Faculty*, 28(1):11-19.

Markevych, I., Tiesler, C. M. T., Fuertes, E., Romanos, M., Dadvand, P., Nıeuwenhuıjsen, M. J., Berdel, D., Koletzko, S. and Heinrich, J. (2014). Access to Urban Green Spaces and Behavioural Problems in Children: Results From the Gınıplus and Lısaplus Studies. Environment International, 71: 29-35.

Oh, K. and Jeong, S. (2007). Assessing The Spatial Distribution of Urban Parks Using Gis. Landscape and Urban Planning, 82(1-2): 25-32.

Oktay, D. (2007). Kıbrıs'taki Kentler, Kentsel Politikalar ve Yeni Açılımlar. Der: Ayşegül Mengi, Kent ve Politika: Antik Kentten Dünya Kentine, Ankara, İmge Yayınevi.

Olgun, R. (2018). Determination of Strategic Objectives and Development of Planning Strategies for Open and Green Spaces of Nigde City. PhD Thesis, Akdeniz Univesity, Antalya.

Olgun, R. and Yılmaz, T. (2017) Türkiye'de kentsel yeşil alanların planlanmasına yönelik yasal düzenlemeler ve uygulamalar. In: Çiftçi N, Kara Y, Yalçınkaya İ, Şahin M, Ağaçayak T (Ed), Fen, Matematik, Mühendislik ve Doğa Araştırmaları. Çizgi Kitabevi, Konya, s. 181-189.

Önen, E. (2015). Identifying of Urban Open Green Space Strategies: The Case Study of Guzelbahce (Izmir). PhD Thesis, Ege University, İzmir.

Özdemir, A. (2009). The Role of Public Green Space on The Formation of Participant Urban Identity. *Süleyman Demirel University Journal of The Faculty of Forestry,* A(1): 144-153.

Park, B. J., Tsunetsugu, Y., Ishii, H., Furuhashi, S., Hirano, H., Kagawa, T. and Miyazaki, Y. (2008). Physiological Effects of Shinrin-yoku (taking in the atmosphere of the forest) in a Mixed Forest in Shinano Town, Japan. *Scandinavian Journal of Forest Research*, 23: 278-283.

Reyes, M., Paez, A. and Morency, C. (2014). Walking Accessibility to Urban Parks By Children: A Case Study of Montreal. Landscape and Urban Planning, 125: 38-47.

Schipperijn, J., Stigsdotter, U. K., Randrup, T. B. and Troelsen, J. (2010). Influences on The Use of Urban Green Space- ACase Study in Odense, Denmark. *Urban Forestry and Urban Greening*, 9: 25-32.

Selim, S. and Karakuş, N. (2016). Sufficiency of Public Open-Green Spaces in Fethiye Town/Turkey and Accessibility Analysis with GIS Techniques. I. Uluslararası Akademik Araştırmalar Kongresi Bildiriler Kitabı (INES 2016), Antalya, Türkiye, 3-5 Kasım 2016, vol.1, ss.82-87.

Selim, S., Karakuş N., Ardahanlıoğlu, Z. B. and Zengin, M. (2014). Fethiye Kenti Açık ve Yeşil Alan Dağılımlarının Cbs Teknikleri ile Analizi. Türkiye Coğrafyacılar Derneği Uluslararası Kongresi, 4-6 Haziran, Muğla, ss.577-585.

Sennet, R. (2002). Ten ve Taş, Çev: Tuncay Birkan Metis Yayınları, İstanbul.

Serik Municipality, (2021). History of Serik District. http://www.serik.bel.tr/ (accessed date: 08.04.2021).

Sister, C., Wolch, J. and Wilson, J. (2010). Got Green? Addressing Environmental Justice in Park Provision. *GeoJournal*, 75(3): 229-248.

So, S. W. (2016). Urban Green Space Accessibility and Environmental Justice: A Gis-Based Analysis in The City of Phoenix, Arizona. Master thesis, Southern California University, Los Angeles, 78 p.

Sugiyama, T., Cerin, E., Owen, N., Oyeyemi, A. L., Conway, T. L., Van Dyck, D., Schipperijn, J., Macfarlane, D. J., Salvo, D., Reis, R. S. et al. (2014). Perceived Neighbourhood Environmental Attributes Associated With Adults' Recreational Walking: IPEN Adult Study in 12 Countries. Health and Place, 28: 22-30.

Sugiyama, T., Leslie, E., Giles-Corti, B. and Owen, N. (2008). Associations of Neighbourhood Greenness With Physical and Mental Health: Do Walking, Social Coherence and Local Social Interaction Explain the Relationships?. *Journal of Epidemiology and Community Health*, 62(5): 1-6.

Şalap Ayça, S., Jankowski, P., Clarke, K. C., Kyriakidis, P. C. and Nara, A. (2018). A meta-modeling approach for spatio-temporal uncertainty and sensitivity analysis: an application for a cellular automata-based Urban growth and land-use change model. *International Journal of Geographical Information Science*, 32(4): 637-662.

Tabassum, S. and Sharmin, F. (2013). Accessibility Analysis of Parks at Urban Neighborhood: The Case of Dhaka. *Asian Journal of Applied Science and Engineering*, 2(2): 48-61.

Taylor, L. and Hochuli, D. F. (2015). Creating Better Cities: How Biodiversity and Ecosystem Functioning Enhance Urban Residents Wellbeing. *Urban Ecosystems*, 18(3): 747-762.

Taylor, L. and Hochuli, D. F. (2017). Defining Greenspace: Multiple Uses Across Multiple Disciplines. *Landscape and Urban Planning*, 158: 25-38.

Thompson, C. W., Roe, J., Aspinall, P., Mitchell, R., Clow, A. and Miller, D. (2012). More Green Space is Linked to Less Stress in Deprived Communities: Evidence from salivary cortisol patterns. *Landscape and Urban Planning*, 105: 221-229.

Turkish Statistical Institute, (2020). Urbanization Rate in Turkey. https://data.tuik.gov.tr/ (accessed date: 08.04.2021).

Ulrich, R. S. (1981). Natural Versus Urban Sciences: Some Psycho-Physiological Effects. *Environment and Behavior*, 13(5): 523-556.

United Nations, (2004). World Urbanization Prospects: The 2003 Revision. United Nations Publication, New York, 323 p.

United Nations, (2014). World Urbanization Prospects The 2014 Revision. United Nations Publication, New York, 27 p.

Van Den Berg, A. E., Maas, J., Verheij, R. A. and Groenewegen, P. P. (2010). Green Space As a Buffer Between Stressful Life Events and Health. *Social Science and Medicine*, 70: 1203-1210.

Van Den Berg, M., Wendel-Vos, W., Van Poppel, M., Kemper, H., Van Mechelen, W. and Maas, J. (2015). Health Benefits of Green Spaces in The Living

Environment: A Systematic Review of Epidemiological Studies. *Urban Forestry and Urban Greening*, 14: 806-816.

Van Herzele, A. and Wiedemann, T. (2003). A Monitoring Tool For The Provision of Accessible and Attractive Urban Green Spaces. Landscape and Urban Planning, 63: 109-126.

Vlad, M. I. and Brătăşanu, D. (2011). Quality of life assessment based on spatial and temporal analysis of the vegetation area derived from satellite images. Romanian Review of Regional Studies, 7(2): 111-120.

Wolch, J. R., Byrne, J. and Newell, J. P. (2014). Urban Green Space, Public Health, and Environmental Justice: The Challenge of Making Cities 'Just Green Enough'. Landscape and Urban Planning, 125: 234-244.

Yaylı, H. (2012). The Effects of Globalization on The Cities: The Case of Istanbul. *The Journal of Social Economic Research*, 12(24): 331-356.

Yenice, M. S. (2012). A Spatial Sufficiency and Accessibility Analysis for Urban Green Spaces: A Case Study for Burdur, Turkey. *SDU Faculty of Forestry Journal*, 13: 41-47.

Zhang, Y., Li, S., Fath, B. D., Yang, Z. and Yang, N. (2011). Analysis of An Urban Energy Metabolic System: Comparison of Simple and Complex Model Results. Ecological Modelling, 223(1): 14-19.

Zou, Y., Torrens, P. M., Ghanem, R. G. and Kevrekidis, I. G. (2012). Accelerating Agent Based Computation of Complex Urban Systems. *International Journal of Geographical Information Science*, 26(10): 1917-1937.

Zhou, D., Xu, J., Wang, L. and Lin, Z. (2015). Assessing Urbanization Quality Using Structure and Function Analyses: A Case Study of The Urban Agglomeration Around Hangzhou Bay (UAHB), China. Habitat International, 49: 165-176.

CHAPTER 6

USE OF GREEN INFRASTRUCTURE COMPONENTS IN SUSTAINABLE CITIES AND EXAMPLES OF GREEN INFRASTRUCTURE

Research Assistant Selin TEMİZEL[1]
Assoc. Prof. Dr. Kübra YAZİCİ [2*]
Prof. Dr. Bahriye GÜLGÜN [3]

[1] Yozgat Bozok University, Faculty of Agriculture, Department of Landscape Architecture, Yozgat, Turkey. E-mail: selin.temizel@yobu.edu.tr. ORCID ID: 0000-0002-8945-8856
[2*] Yozgat Bozok University, Faculty of Agriculture, Department of Landscape Architecture, Yozgat, Turkey. E-mail: k-yazici-karaman@hotmail.com ORCID ID: 0000-0002-6046-1648
[3] Ege University, Faculty of Agriculture, Department of Landscape Architecture, İzmir, Turkey. E-mail: bahriye.gulgun@ege.edu.tr ORCID ID: 0000-0002-7071-8486

INTRODUCTION

Today, environmental, psychological and sociological pressures caused by rapid and unplanned urbanization with the population increase are the biggest problems that the city and living creatures in the city are exposed to (Gülgün Aslan and Yazici, 2016). Especially the increase in migration brings along slums and concreting, and with the increasing demand and consumption, ruins the unique ecosystem of the city. In addition, the permeable surfaces are decreasing in cities that are rapidly concrete, and the drift of precipitation from the city system as a drain is getting harder with each passing day (Demir, 2012; Ekşi, 2016).

The increase in impermeable hard surfaces, that is, the decrease in soil and green surfaces where water can drain, and the lack of permeable building materials prevent the natural water cycle and infiltration process in urban areas. In cities where surface flow is uncontrolled, rain water that cannot reach the soil passes to surface flow. This situation brings along uncontrolled increasing surface flow, floods and overflows as well as increasing the amount of erosion experienced in river beds. In urban areas, drainage has tried to be provided with the existing gray infrastructure that rapidly diverts rainwater from the environment, but since analysis and evaluation processes based on landscape character cannot take their place in practice, natural resources have continued to disappear irreversibly (Çakıroğlu, 2011; Korkut, Gültürk and Topal, 2016; Gülgün Aslan and Yazici, 2016). Stormwater management strategies in cities are important for retention and reuse of rainwater runoff (Hepcan and Hepcan, 2018; Saygın and Ulusoy, 2011;

Çetinkaya, 2014). In recent years, to minimize these problems, the issue of sustainable management of rain water has come to the fore (Figure 1).

Figure 1. Green infrastructure example implemented in the central median (URL 1)

With sustainable drainage, the aim is to preserve the volumetric balance of runoff, infiltration, evaporation and perspiration as much as possible and to create conditions equivalent to hydrological processes before urbanization (Samanlı, 2018).

In this context, green infrastructure applications are frequently encountered in providing sustainable urban drainage (Figure 2).

Figure 2. Applied green infrastructure example (URL 2; URL 3)

Green infrastructure; It is a network where open and natural areas are interconnected that manage rainwater, reduce the risk of flooding and improve water quality. Green infrastructure implementation and maintenance are generally less costly than traditional forms of infrastructure. In addition, green infrastructure projects also strengthen social solidarity as they include residents of the relevant region / area in the planning, planting and maintenance phases. One of the most important elements of green infrastructure systems is to protect water resources and to ensure their sustainability (CNT, 2012; Özeren, 2012; Güneş Gölbey and Kaylı, 2020).

Figure 3. Applied green infrastructure example (URL 4)

This book section; In cities with green infrastructure applications, it is aimed to inform about creating conditions that allows access to ecological and hydrological processes before urbanization. Within the scope of the study, green infrastructure applications that are used / recommended to be used intensively in and around the city, applications that protect and develop the green texture that allow the increase of permeable surfaces in cities, green infrastructure applications placed in the urban texture to facilitate urban drainage; Green street, green sidewalk / pedestrian pathway and green parking practices, the concept of sustainable city with an ecology-based approach, are examined.

1. GREEN SIDEWALK / PEDESTRIAN PATHWAY APPLICATIONS

The streets that have green sidewalks and green pedestrian pathway applications are important opportunities to create an infrastructure system with environmentally friendly and holistic approaches while creating sustainable cities. In these applications, components such as permeable surfaces, rainwater ditches, open or closed water collection, natural or artificial drainage gutters are used in green pavement /pedestrian pathway applications. Among these works carried out within the scope of green infrastructure; There are pavement extensions formed by plant clusters, pedestrian pathway plantings, tree barriers and permeable paving stones (Semiz, 2016). While the circulation of pedestrian and non-motorized vehicles in the city is regulated with green pavement / pedestrian pathway applications, practices aimed at reducing the amount of precipitation that can pass to runoff are integrated into the system within the scope of green infrastructure. In these spaces where the functionality of nature is used, the users use the natural and aesthetic spaces they desire, while urban drainage is also supported.

Figure 4. Rain gardens (URL 5)

2. GREEN PARKING APPLICATIONS

In urban transportation, car parks where private vehicles are used extensively are considered an important part of public life and city life. It is one of the most important spatial applications where permeable surface coatings are the most functional due to the size of the surface volume they cover, and therefore, impermeable surface coatings should resources, and support the reuse of rainwater (Ünal and Akyüz, 2018). Green infrastructure applications are important in terms of hydrological cycle and ecological city development in urban areas with these advantages they provide. In particular, the recovery and reuse of rain water by separate collection and treatment will be an important component for urban, regional and national water resources management (Avdan et al., 2015).

Figure 5. Example of green infrastructure applied in the parking lot (URL 6)

3. GREEN STREET APPLICATIONS

Within the scope of green street applications, impermeable hard / structural surfaces on the streets are recoated with permeable surfaces by changing the material. During this application, aesthetic and functional planting studies are carried out by integrating suitable species to soil areas, vegetative bands, plant ponds and containers, and have positive cleansing effects on rainwater that passes through the runoff, suitable for urban texture. The correct planting studies in green street applications provide a space perception reduced to human scale in the perception of high and voluminous buildings in urban spaces. According to Gray and Katzenmoyer (2011), various studies show that the presence of 40% tree clusters in urban areas can provide a significant reduction in rainwater flow. In addition, rainwater management practices such as rain ditches and rain gardens are also seen in green street works within this scope.

Figure 6. Green street example (URL 7)

4. GREEN ROOF APPLICATIONS

In recent years, the term green infrastructure has been used for all ecology-based approaches, from green roofs to environmentally friendly rainwater management systems. Within this diversity, all the mentioned approaches emphasize the interconnectedness of the built environment and ecological environment (Özdemir, 2009). It has been showed an example of green infrastructure used on roofs on Figure 5.

Figure 7. An example of green infrastructure applied on roofs (URL 8)

5. COMPONENTS INCLUDING IN GREEN INFRASTRUCTURE SYSTEMS

Rainwater management in cities is associated with the green infrastructure system. In order for a correct green infrastructure system to be formed, the system must have integrity from the design stage to its components. In order to ensure this integrity from the inception stage, the system must be built with a certain criterion. In the study based on ensuring sustainability with green infrastructure applications in rain water management in cities, green infrastructure must be evaluated within the framework of eligibility criteria for planning, design, ımplementation stages. Eligibility criteria can be divided into 3 subgroups.

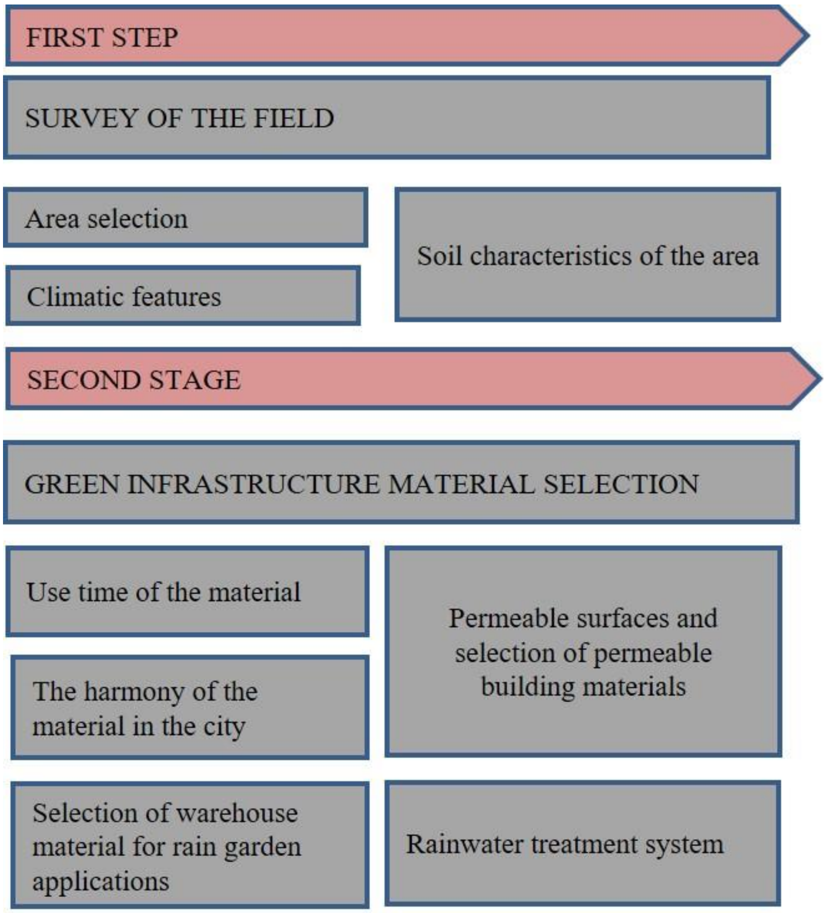


Figure 8. First and second stages in green infrastructure applications

In short, while designing green infrastructure systems, the applications, designs and functionality prepared to create healthy and sustainable urban drainage systems must be created the most accurate and rational way. For this, the application area should be ecologically based and the effect of global warming should be considered in the coming years.

As can be seen from the sections in the works with permeable and non-permeable infrastructure systems, permeable surfaces, green belts, drainage ditches are energy-free units that naturally enable rainwater to be collected and transferred to groundwater. Integration of these systems in urban areas with healthy and sustainable approaches is of great importance in terms of minimizing the risk of disaster formation.

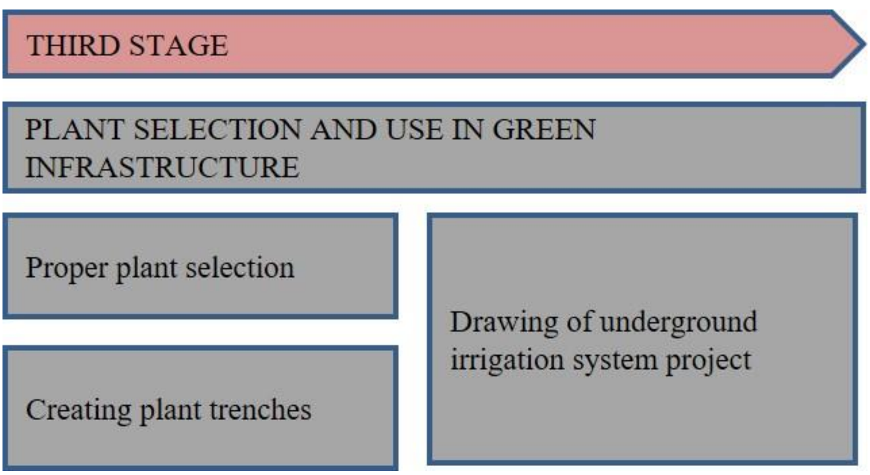


Figure 9. Third stage in green infrastructure applications

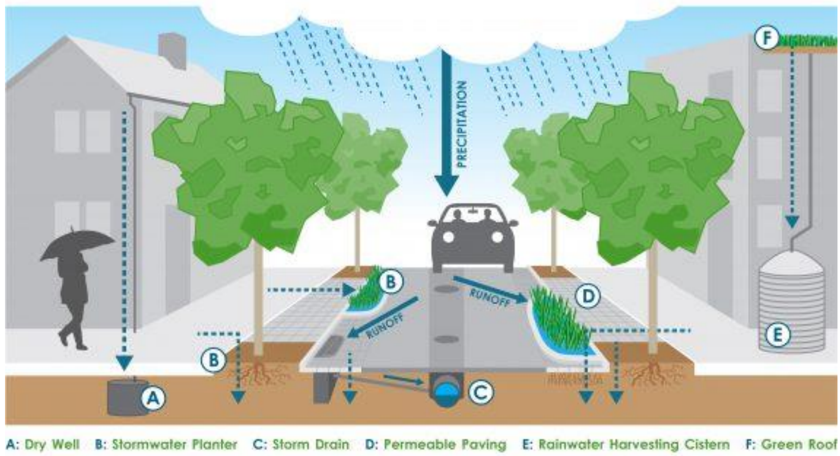


Figure 10. Green infrastructure street application (URL 9)

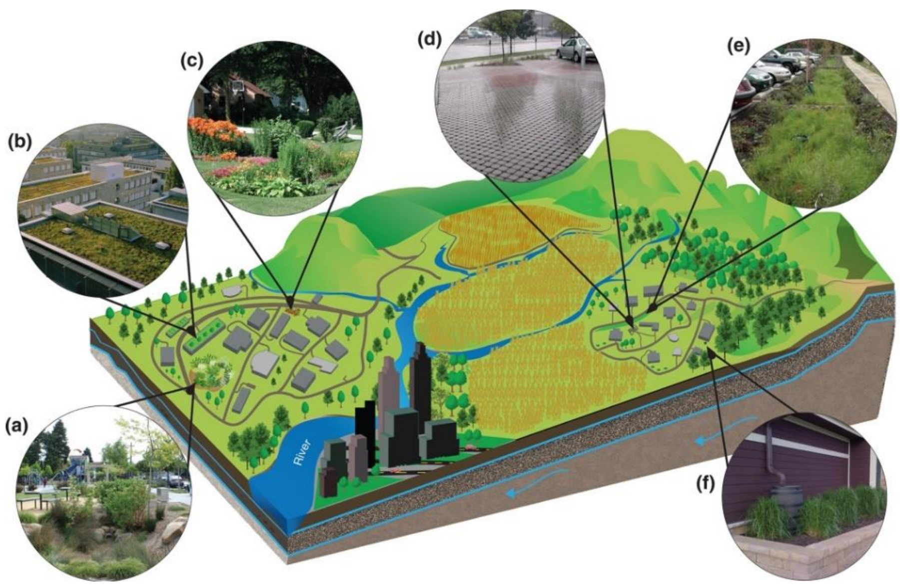
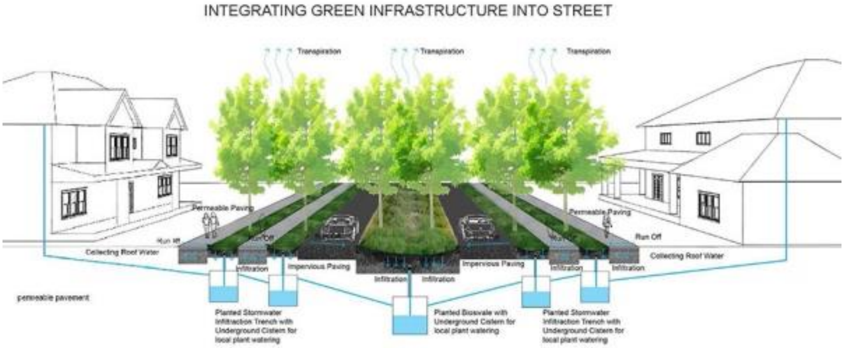


Figure 11. Green infrastructure applications (a: rain garden, b: Green roof; c: permeable surfaces; e: permeable living ground; f: rain tanks) (URL 10)



(a)

(b)

Figure 12. Green infrastructure applications (a and b) (URL 11)

Green Streets guidelines, an example of Cole Grade Road upgrade project aiming to complete in 2020.

Figure 13. Green infrastructure pavement application (URL 12)

6. EXAMPLES OF APPLICATION APPROACHES IN GREEN INFRASTRUCTURE SYSTEMS

Green infrastructure applications attract attention especially in China and Japan. Among these practices, it is seen that the Japanese islands with an area of 392 hectares in Japan are an important wetland. The Japanese islands, extending from the sub-arctic region to the subtropical regions and parallel to the eastern edge of the Eurasian Continent, consist of four main islands and 3900 small islands. When the existing areas with green infrastructure system are examined, the green area of Shanghai Houtan park per person is 0.005 m². Shanghai is one of the cities with the highest population in China as a city. For this reason, it is seen that the green area per person in Shanghai Houtan park is relatively low. The amount of green space per person on the Qinhuangdao beach is 0.15 m². It is seen that the population of Qinhuangdao city is less than Shanghai and the amount of coastal area is higher, which positively affects the amount of green space per person. The amount of green space per person in Tianjin Qiaoyuan park is 0.014 m². Due to the large population of Tianjin as a city, it is seen that the green area per capita in Tianjin Qiaoyuan park is relatively low (Gülgün Aslan and Yazici, 2016).

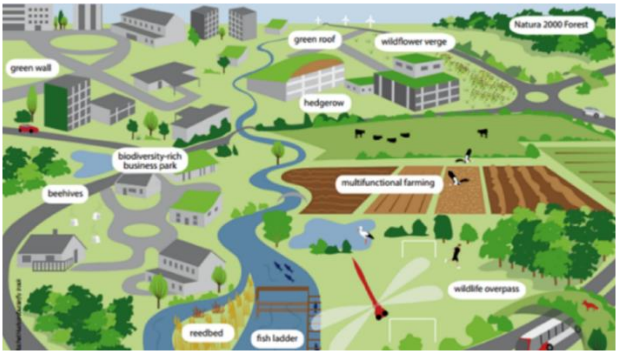


Figure 13. Green infrastructure application in a city (URL 13)

Figure 14. Hansekala VIA Getty application (URL 14)

It is seen that the applied green infrastructure systems not only contribute positively to the ecosystem, but also create spaces with high visual quality as a landscape element. Pavements such as asphalt cause rainwater overflow and increased pollutant levels in waterways. With a green infrastructure system, it can reduce rainwater flow and improve water quality. A green infrastructure system that it can reduce rainwater flow and improve water quality. San Diego County's Green Streets program incorporates numerous green infrastructure design elements, including tree wells, biofiltration rain gardens, rock gardens, and permeable pavement.

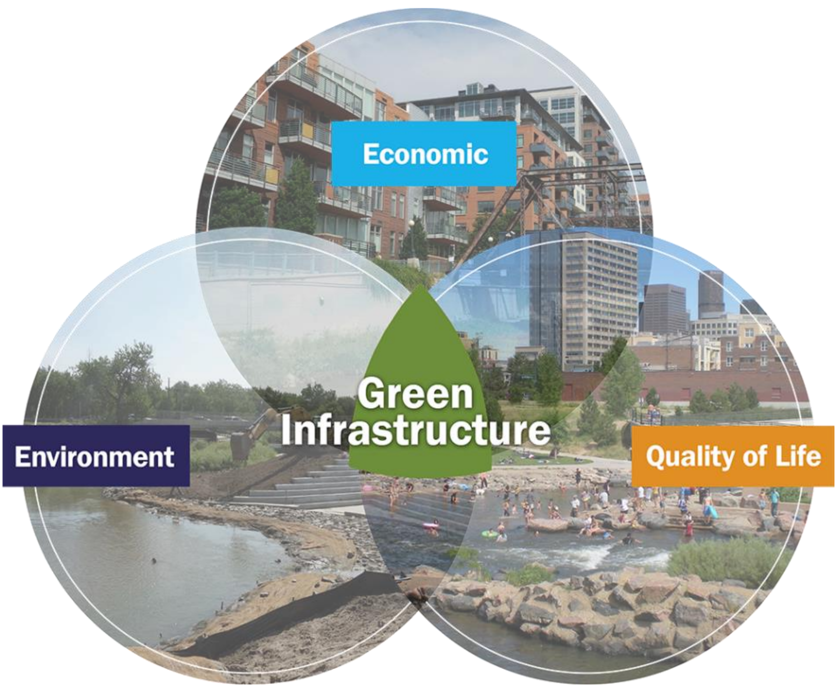


Figure 15. Combination of Environment, Quality life and Economy (Green infrastructure) (URL 15)

In green infrastructure systems, the importance of the sprinkler system is revealed with the projects carried out.

Figure 16. Green infrastructure rainwater tanks (URL 16; URL 17)

Figure 17. Green infrastructure rainwater tanks (URL 18)

Figure 18. Green infrastructure rainwater tanks (URL 19)

Figure 19. Green infrastructure roof example (URL 20)

Figure 20. Green infrastructure roof example (URL 21)

Figure 21. Green infrastructure example (URL 21)

7. CONCLUSION

Increasing impermeable surfaces in urban areas with the environmental problems in the urbanization process lead to the loss of rain water and climate change by creating an urban heat island effect. Changing climatic conditions and experienced global warming negatively affect the world to a great extent.

With the melting of polar glaciers with global warming, fresh waters mixed into sea waters rapidly evaporate with rising temperature values and cause very intense amounts of high-volume precipitation. Waters accumulated by impervious surfaces are encountered as disasters in different ways in many cities of the world today.

Green infrastructure helps the deteriorating hydrological cycle due to urbanization and climate change to approach its pre-urbanization state. This situation is important in terms of contributing to the sustainability of urban areas. Permeable surface coatings, rain gardens, plant ditches, street afforestation, which are applied as green infrastructure components, reduce the amount of runoff and help feed groundwater by infiltrating rainwater underground. In addition, vegetation helps to increase the amount of evaporation on the surface. Thus, it may be possible to reduce the effects of adverse conditions caused by climate change. The green infrastructure components discussed in this study were questioned with a question and answer system, and used to contribute to sustainable drainage systems by collect rainwaters on city part, which was fictionalised in the light of the data obtained. Area, design, implementation and sustainability compliance was examined, steps were taken towards the establishment of green infrastructure design principles.

It is necessary to develop green infrastructure projects to meet the water needs of plants with rainwater, to prevent water flow on asphalt or concrete floors, to reduce visual pollution, as well as to develop new steps similar to these issues and new solutions to the problems that occur. Restoration works should be done in this direction, especially in the coastal cities of our country. Since vegetation is an important building block in green infrastructure systems, the plants should be selected suitable for the region in the projects. In areas open to visitors, restrictive green corridors should be established for animals living in nature. Projects that ensure the protection of soil-water resources as well as natural habitats of flora and fauna should be created and such projects should be supported. This system, which is applied in the drainage works to be carried out within the scope of green infrastructure applications, is expected to be functional in other green infrastructure applications.

REFERENCES

Anonim 1 (2020). (**a**) Deaderick Street, https://www.hawkinspartners.com/deaderick-street. Erişim: Temmuz 2020. (**b**) Mobilya Passeing Sant Joan, https://pallarsfustes.com/projectes/projectes-mobiliari-passeig-sant-joan/. Erişim: Temmuz 2020. (**c**) Public Seating Furniture, https://tr.pinterest.com /brsbkc/public-seating-furniture-bench/. Erişim: Temmuz 2020.

Anonim 2. (2020). (**a**) Bourke Street Cycleway, https://www.pinterest.com.au/ pin/519813981989959764/. Erişim: Temmuz 2020. (**b**) Green Streets, Portland, Oregon, https://www.trees.org.uk/Trees.org.uk/files/d9/d94feb31-759d-40d9-8abd-48715df32f7e.pdf. Erişim: Temmuz 2020. (**c**) Streetscape design, https://tr.pinterest.com/pin/738871882596127671/. Erişim: Temmuz 2020.

Anonim 3. (2020). (**a**) Modern Landscaping Design Steps, https://www.pinterest .es/pin/296745062951189171/. Erişim: Temmuz 2020. (**b**) Landscape architecture park, https://www.pinterest.fr/pin/294915475602283908/. Erişim: Temmuz 2020. (**c**) Groen en waterdoorlatende bestrating, https://tr.pinterest.com/pin/861594972437144743/. Erişim: Temmuz 2020.

Avdan, Z., Yıldız, D. ve Çabuk, A. (2015). Yağmur Suyu Yönetimi Açısından Yeşil Altyapı Sistemlerinin Değerlendirilmesi. ISBS.

Çetinkaya, G . (2014). Kentsel Peyzaj Ekolojisinin Sürdürülebilirliği İçin Yenilikçi Bir Yaklaşım: Yeşil Altyapı ve Planlama Politikası. İDEALKENT , 5 (12) , 218-245 .

Demir, D. (2012). Konvansiyonel Yağmursuyu Yönetim Sistemleri ile Sürdürülebilir Yağmursuyu Yönetim Sistemlerinin Karşılaştırılması: İTÜ Ayazağa Yerleşkesi Örneği", İstanbul Teknik Üniversitesi, Fen Bilimleri Enstitüsü, Çevre Mühendisliği Anabilim Dalı, Yüksek Lisans Tezi, İstanbul.

Doğangül, Ö. ve Doğangül, C. (2009). Küçük ve Orta Ölçekli Yağmur Suyu Kullanımı.

Ekşi, M. (2016). Yağmur Bahçelerinin Nicel Değerlendirilmesi: İstanbul Üniversitesi Orman Fakültesi Örneği", *Gazi Üniversitesi Mühendislik ve Mimarlık Fakültesi Dergisi,* 31(4), 1113-1123.

Gülgün Aslan, B and Yazici, K. (2016). Yeşil Altyapı Sistemlerinde Mevcut Uygulamalar Ziraat Mühendisliği, (363), 31-37 Retrieved from https://dergipark.org.tr/en/pub/zm/issue/38892/454275 Accessed Date: 12.01.2021

Gray, J.R. and Katzenmoyer, C. (2011) The City of Lancaster. Green Infrastructure Plan Lancaster.

Kaylı, A. Güneş Gölbey, A. (2020). Yeşil Altyapı ve Yeşil Bina Bileşeni Olarak Kurakçıl Peyzaj Uygulamaları. *Ege Üniversitesi Ziraat Fakültesi Dergisi* 57 (2020): 303-311.

Korkut, A., Gültürk, P. ve Topal, T. (2016). Kentsel Peyzaj Yapılarında Zemin Geçirimliliği Üzerine Bir Araştırma: Tekirdağ Örneği. *Kastamonu Üniversitesi Orman Fakültesi Dergisi,* 16(2):412-422.

Müftüoğlu, V. ve Perçin, H. (2015). Sürdürülebilir Kentsel Yağmur Suyu Yönetimi Kapsamında Yağmur Bahçesi. *İnönü Üniversitesi Sanat ve Tasarım Dergisi,* 11(2015):27-37.

Özdemir, A. 2009. Peyzaj Tasarımında Yağmur Suyu Denetimi. *Peyzaj Mimarlığı Dergisi*, 2009/1, 77-89.

Samanlı, V. (2018). Sürdürülebilir Kentsel Drenaj Sistemleri. *Su ve Çevre Teknolojileri Dergisi,* 125(2018):38-40.

Saygın, N. ve Ulusoy, P. (2011). Sürdürülebilir Kampüs Tasarımı için Yağmursuyu Yönetimi ve Yeşil Altyapı Teknikleri. *Politeknik Dergisi* 14 (2011): 223-231.

Semiz, M. (2016) Yeşil Altyapı Sistemleri ile Kent Sürdürülebilirliği İlişkisi (Yüksek Lisans Tezi). Mimar Sinan Güzel Sanatlar Üniversitesi Fen Bilimleri Enstitüsü.

Ünal, U. ve Akyüz, D. (2018). Yeşil Altyapı Uygulamaları Kapsamında Yağmur Hendeklerinin Önemi ve Sürdürülebilir Kent Anlayışı ile Değerlendirilmesi. İklim Değişikliği ve Çevre, 3(2):55-63.

URL 1. https://youngwaterleaders.thewaternetwork.com/article-FfV/want-resilient-cities-try-a-national-policy-on-green-infrastructure-fagKDxyP9iPOlz7G-YLoPQ Accessed Date: 12.01.2021

URL 2. https://chesapeakestormwater.net/2015/12/stormwater-program-specialistarlington/ Accessed Date: 12.01.2021

URL 3. http://www.g-a-l.info/watershedinfo.html Accessed Date: 12.01.2021

URL 4. Pinterest Accessed Date: 12.01.2021

URL 5. https://www.waterworld.com/urban-stormwater/stormwater-management/article/14039425/nyc-doubles-size-of-largest-green-infrastructure-program-in-nation Accessed Date: 12.01.2021

URL 6. https://www.burohappold.com/articles/making-economic-case-greeninfrastructure-investment/ Accessed Date: 12.01.2021

URL 7. https://hpigreen.com/tag/green-streets/ Accessed Date: 12.01.2021

URL 8. https://info.ecogardens.com/blog/how-to-maintain-green-infrastructure-forpeak-performance-year-round Accessed Date: 12.01.2021

URL 9. https://tomorrow.norwalkct.org/news/cities-incorporating-greeninfrastructure-help-storm-surges/ Accessed Date: 12.01.2021

URL 10. https://onlinelibrary.wiley.com/doi/full/10.1002/wat2.1254 Accessed Date: 12.01.2021

URL 11. https://www.umass.edu/larp/file/meilan2jpg Accessed Date: 12.01.2021

URL 12. https://www.wsp.com/en-CN/insights/providing-guidance-for-green-infrastructure-in-southern

URL 13. https://www.weadapt.org/knowledge-base/cities-and-climate-change/urbangreen-infrastructure-an-introduction Accessed Date: 12.01.2021

URL 14. https://www.denvergov.org/content/denvergov/en/wastewatermanagement/stormwater-quality/green-infrastructure.html Accessed Date: 12.01.2021

URL 15. https://www.nrdc.org/stories/green-infrastructure-how-manage-water sustainable-way Accessed Date: 12.01.2021

URL 16. https://www.epa.gov/green-infrastructure/what-green-infrastructure Accessed Date: 12.01.2021

URL 17. https://www.epa.gov/green-infrastructure/what-green-infrastructure/ Accessed Date: 12.01.2021

URL 18. https://www.nrdc.org/stories/green-infrastructure-how-manage-water-sustainable-way Accessed Date: 12.01.2021

URL 19. https://www.grocotts.co.za/2018/03/20/whos-responsible-for-supplyingrain water-tanks-landlord-or-tenant/ Accessed Date: 12.01.2021

URL 20. https://inhabitat.com/new-yorks-high-line-park-to-double-in-size-by-nextspring/hl_wildflower_field/ Accessed Date: 12.01.2021

URL 21. https://doee.dc.gov/service/types-green-infrastructure/ Accessed Date: 12.01.2021

CHAPTER 7

RENEWABLE ENERGY SOURCES IN LANDSCAPE ARCHITECTURE: ENERGY FORESTS

Prof. Dr. Murat Ertuğrul YAZGAN [*]

[*] Siirt University, Faculty of Agriculture, Department of Landscape Architecture, Siirt, Turkey. E-mail: me-yazgan@hotmail.com ORCID ID: 0000-0003-3014-8367

INTRODUCTION

The rapid increase in the world population, the continuous growth of the gap between energy production and consumption, and the uncontrolled increase in oil prices have caused serious economic measures to be taken in many countries. The development of technology and therefore the industry has brought the need for energy and significantly increased the price of oil, which is a quality energy source. The fact that the industry is more advanced in developed countries has affected these countries more and caused them to encounter great difficulties in meeting their energy needs adequately.

Towards the end of the 1900s, approximately 75% of the population of developing countries became dependent on firewood. More than half of these have caused ecological, environmental and socio-economic disasters by cutting down forest areas in order to provide the necessary firewood. In the same years, the fact that known energy resources were exhaustible encouraged many countries to benefit from new and renewable energy sources. Forest biomass is one of the most important resources in renewable energy resources.

Biomass (biomass) is the thought of a community of trees and shrubs in a forest area of a certain size as a living mass, a pile. Biomass per unit area is specified as weight (kg, ton / ha). This weight can be wet or oven-dry. However, oven-dried weight is a more meaningful evaluation. In researching the energy potential of forests, all components of trees should be taken into account. Unfortunately, in current forest inventories, the general purpose is to estimate the volumes of non-bark logs for commercial tree species alone. The world's annual biomass production is equivalent to a rough estimate of 4.3 billion tons of dry weight, and 2/3 of this amount is not firewood. The energy value of the biomass resources of the world's forests, which are not utilized today, is approximately 1.2 billion tons of oil equivalent per year or 15% of the world energy consumption. Due to the technical, economic and environmental problems that arise in the cutting and transportation of logs, only a small part of this capacity will be produced and consumed as a fuel resource that can be used instead of oil in the future (Saraçoğlu, 1997).

Biomass energy is generated as a result of green plants' storage of solar energy by converting it into chemical energy through photosynthesis. Bioenergy is a continuous energy source that does not create environmental pollution. Biomass energy is obtained in two ways, traditional and modern. Burning wood and plant and animal waste obtained from forests for heating and cooking is the traditional method. The modern method is to obtain heat, electricity, liquid and gaseous fuels from wood, agricultural products, agricultural wastes and organic wastes by methods such as fermentation, esterification, gasification, pyrolysis (TÇV, 2006).

The limited raw material and energy resources and the rapid increase in energy needs can be shown as the reason for human beings to search for alternative energy resources. It is a fact that the resources currently available will one day be exhausted with the future population explosion and the increase in living standards. Situations such as the depletion of fossil fuels, which take centuries to renew, and the use of costly energy types, have brought climate change, disasters and related environmental problems caused by greenhouse gas emissions. This has made it necessary to find options for new energy sources.

For this purpose, it may be possible to use the planned and unplanned plantations and the arid lands that are excluded from food agriculture or cannot be used in the cultivation of energy crops. Countries that can use technology effectively use forests and plantations, waste, even various algae for energy production.

1. BIOMASS ENERGY

In the future, most of the energy used in the world will be obtained from plants. Moreover, it would not be necessary to take these plants, which have been fossilized for thousands of years, out of the ground with expensive and complex technologies. It is expected that oil prices in the global market will continue to rise and as a result, biomass cultivation will develop rapidly. Obtaining bioenergy from forests is not cutting and burning aged and mature forests. This is to create new forest plantations for energy extraction. Growing fast-growing trees such as black poplar, balsam poplars, aspen, willow, eucalyptus and cynara in semi-arid areas for energy purposes is called energy forestry. Research on the cultivation of willow trees for energy purposes is still ongoing. It is possible to obtain approximately 7 million tons of biomass energy resources annually from the energy forests to be established on an area of one million hectares. This is equivalent to 30 million barrels of crude oil. Low-yielding forests, inefficient scrub and scrub, damaged coppice can be evaluated as energy forests. 4 million hectares of Turkey's forests are degraded coppice and these areas can be devoted to energy forest cultivation. Biomass cultivation supports the maintenance of degraded forest areas to become profitable, the protection of natural habitats, the utilization of inefficient and abandoned lands with energy crops that require low inputs, the creation of new habitats, the protection and enhancement of biological diversity. In terms of creating a business area, biomass energy creates 11 times more job opportunities than nuclear energy and 3-6 times more than fossil fuels in the stages of cultivation, production, processing and distribution. Considering all these benefits of biomass energy, the EU has focused on seeking methods that will enable the expansion of energy agriculture and forest areas and increase efficiency in combating climate change, and has decided to support such studies. In the long term, it is expected that 20% of the EU's energy consumption will be met from biomass and energy agriculture will be carried out on 20 million hectares of land. Their efficiency is low due to the discontinuity of wind, solar and wave energies. In addition, biomass has become important as a new and renewable energy source due to the long research and large investments required of energy resources such as wind, solar, hydroelectric and geothermal. "Energy Growing" is emerging as a new sector in the world in search of minimizing dependence on oil (Günay, 2011).

It is possible to use biomass energy in transportation, heating and electricity generation by using technologies developed for this subject. Technologies specialized in this area are the products of the carbon in the plant, taken by photosynthesis, and not all are used to obtain biomass energy. The above-ground organs, roots and stems of the plants are left in the soil. Thus, it provides the soil to be protected from erosion with the residues left behind by the plant used for biomass energy, and to add soil quality protective substances such as humus to the soil. It would be beneficial to consider biomass energy in this sense as well. With the biomass energy approach, the world in search of alternative energy both turns a biological source into energy in an ecological way and does not harm natural cycles by keeping environmental effects at a minimum. Biomass can be transformed into various solid, liquid and gaseous fuels with biological techniques and energy conversion techniques developed within this framework, and the energy produced can be used in different forms.

Generally speaking, forests constitute a large amount of biomass reserves on earth. Despite the fact that the human population consumes about half of the annual forest biomass growth, still artificial and natural forests are ranked first as a renewable energy source. Researches has shown that the energy contained in the plant through chemical bonds is equivalent to approximately ten times the annual energy requirement of the world. This makes biomass energy indispensable for the rapidly increasing world population. In addition, biomass energy is also beneficial in reducing the rising greenhouse gas emissions, especially in areas close to intensive urbanization. Unlike most other renewable energies, a sustainable biomass energy stands out with its storable feature, since it is neutral in soil enrichment and CO^2 emission. Figure 1 shows carbon recycling, Figure 2 shows the ways of obtaining heat and energy from biomass.

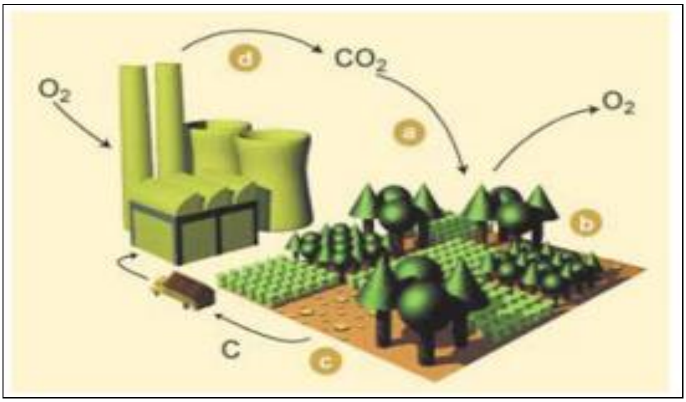


Figure 1. Carbon recycling (Cısdık, 2008)

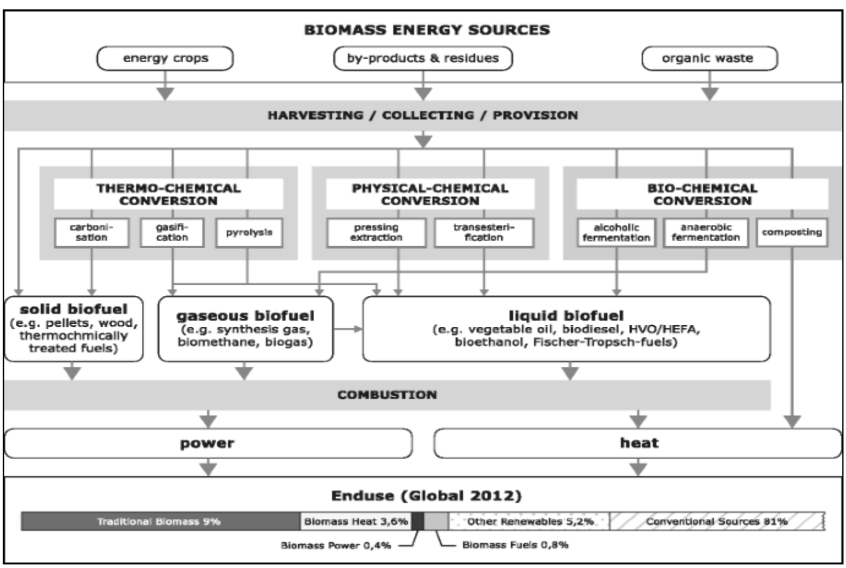


Figure 2. Ways to obtain heat and energy from biomass (URL 1)

Another advantage of biomass energy is that it can be harvested or collected when necessary and transported to user centers and stored. Biomass production cost is high in many countries. The reason for this is the development of biomass resources, that is, more effective utilization of energy products and living wastes, and the absence of a well-functioning biomass market. Although developed countries support the aquaculture sector with subsidies in order to maintain the living standard and not to lose their market shares, reasons such as climate change, melting of glaciers, floods and landslides, erosion, drought, aridity and desertification, industrialization and urbanization, pollution and fires restrict biomass production. These negative impacts are not on a country basis and may affect a large region and even a large part of the world. All these demonstrations show that an international biomass market should be established that will provide more conscious and planned use of biomass energy resources on a local and global scale. In addition, forests to be controlled and developed in a sustainable manner will benefit and create employment for people living in and outside the forest through forest care and evaluation of their products.

Energy products can be obtained from annual, herbaceous and perennial woody plant species. The most widely used and most efficient method in modern energy forestry is the short-cycle cultivation method with fast-growing species that can reproduce from their logs when their trunks are cut. Tree types such as poplar, eucalyptus, maple, and false acacia are used according to climate, hydrology and soil characteristics. According to ecological conditions, typically 3-5, up to 10-15 years old trees are cut, leaving roots and a short trunk in the soil, and an average yield of 10-15 tons of dry product / ha / year is obtained. Due to the harvesting after trunk diameter formation in our country, slow growing oak species are used in this type of energy forestry, which is called coppice in forestry. This harvesting application made on existing oak groves is called rejuvenation. However, oak species are very slow growing and therefore low biomass production. For this reason, they are plants that are not used both in bare land afforestation and in obtaining biomass energy.

2. BIOENERGY AND TURKEY

Turkey intensively needs energy due to rapidly increasing population density, current young population density and sectors such as urbanization, transportation and transportation. However, the insufficiency of the current conditions made it necessary to depend on foreign sources. A low-cost, reliable, easy-to-operate and easy-to-transport energy asset will significantly increase the development level of the country. Figure 3 shows Turkey's primary energy resources production.

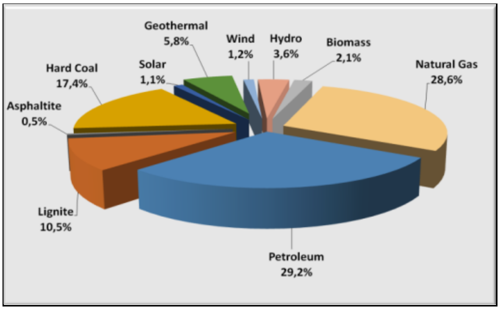


Figure 3. Turkey's primary energy resources production (URL 2)

Like many countries in the world, all of the forest areas in Turkey are not in the nature of fertile forests, and the forest existence is normal, degraded and very degraded coppice forests. Although it comes to mind that the degraded coppice forest area can be reformed and transformed into energy forestry, this is quite difficult in practice. Because coppice do not contain species suitable for breeding principles for modern biomass energy production. It would be appropriate to grow fast growing tree species such as poplar, willow, acacia, eucalyptus, alder to produce energy with biomass. Countries that produce biomass energy generally produce the chips, branches, barks, crown pieces, logs and roots of the wood they produce from energy forests, wood products that cannot be used in the market, agricultural plant stalks and wastes, sawdust and wood waste generated in the production process in the wood industry, in heat facilities. It uses it in electricity and heat generation by burning. Thus, these countries make a great contribution to their renewable energy potential. Socio-economic issues related to biomass production and utilization of energy are listed as follows (Cısdık, 2008):

- Social Dimension Aspect
  - Life standard
  - Environment
  - Health
  - Education
  - Social cohesion and stability
  - Migration effects

- Regional development
- Rural variety

- Macro Level Aspect
- Supply security / risk diversity
- Regional growth
- Shrinking regional trade balances
- Export potential

- Supply Aspect
- Increased efficiency
- Increasing competition
- Population and mobility of the population
- Improved infrastructure

- Demand Aspect
- Employment
- Income and wealth formation, distribution
- Investments
- Supports provided to relevant industries

- Institutional Aspect
- Democratic decision process
- Participatory problem solving
- Solving regional problems

3. FOREST PRESENCE IN TURKEY

The distribution of forest assets in a region depends on the climate of that region, soil structure, water resources, geomorphological structure and similar characteristics of the region. In addition, the results of the vital warfare between plants and tree species with different characteristics are also effective. Unfortunately, many of the existing natural forests in today's Turkey have been damaged by unconscious users and destruction. As a result, more durable but less valuable formations such as maquis, steppe and steppe flora began to replace forest areas. Figures 4 and 5 show the percentage distribution of forest assets in Turkey by regions and provinces.

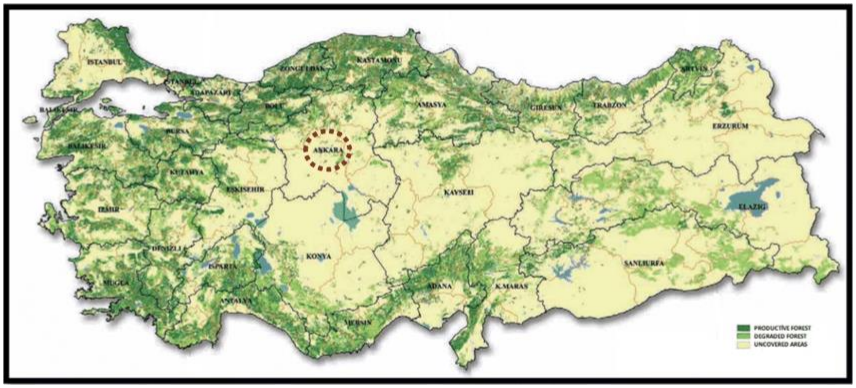


Figure 4. Forest existence map of Turkey (URL 3)

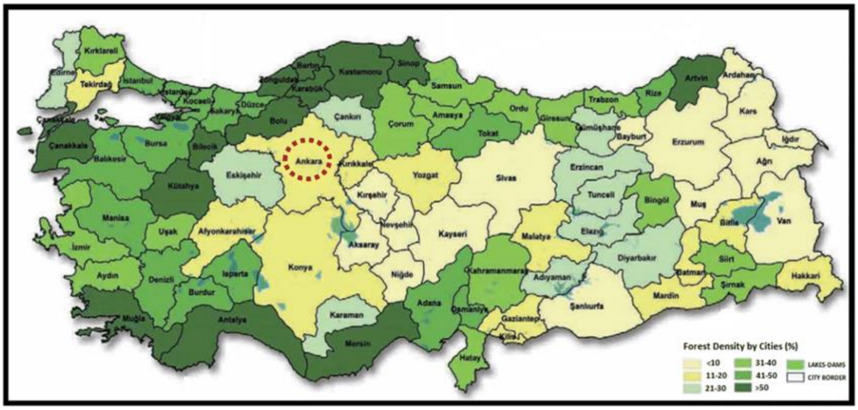


Figure 5. Forest percentage in Turkey by provinces (URL 4)

4. ENERGY FORESTS IN TURKEY

Living conditions based on traditional energy in our country and in the world are increasing with civilization and increasing population. Environmental damage requires long-term, planned and scientific studies. This situation raises the need for intensive studies on new energy sources and alternative energy types and renewable energy sources other than existing ones.

These studies are divided into two groups. These are forest regeneration and forest maintenance activities. In Turkey, these studies are carried out in natural forests that have not been destroyed to a great extent, artificial forests established with afforestation works and in coppice forest areas that can be improved. Studies are determined according to habitat characteristics, tree species of forests, establishment characteristics and operational purposes.

5. ENERGY FORESTS APPLICATIONS

In Turkey, forests are used only for fuel wood production in terms of energy production. However, in recent years, authorities have added strategies to support energy forestry in their development plans, and sought financial support. In this context, in the improvement of energy forests consisting of degraded and slow growing oak groves, the concept of energy forest is tried to be widespread by giving the villagers the role of rejuvenation and protection. However, it can be said that this is more of a new application. Even if the afforestation works of the open and degraded forest areas in our country with the forest tree species of the region are carried out with the highest possible efficiency, the cultivation of energy forests and their transformation into energy to be processed is a work that will take many years.

The following reasons play an important role in this:

- Lack of cadastre works,
- Using forest trees as animal food and forest destruction,
- Low socio-economic welfare level of the local people,
- Difficulty in accessing the forest area,
- Installation costs of facilities that will process forest products,
- Unconscious public approach,
- Lack of academic knowledge and support etc.

6. CONCLUCION

The fact that the flow of energy and energy problems are global in the globalizing world has led especially developed countries to seek solutions in this regard. The concepts of alternative energy and renewable energy are emphasized as well as reducing the uses that cause carbon emissions in the world, giving importance to energy insulation and saving, environmentally friendly designs. Research has shown that wood and woody biomass contained in artificial and natural forests also occupy a large place among the renewable energy sources. For this reason, developed countries have started to use some of their investments to facilitate energy production from forest biomass with more efficient use of technologies required for processing biomass. The amount of energy stored in the form of energy by photosynthesis is equivalent to approximately ten times the annual energy requirement of the world. Forest trees constitute a large amount of this biomass.

The benefits of energy forests can be listed as follows:

- Evaluation directly or by converting to charcoal, liquid and gaseous fuels and burning
- Reducing greenhouse gas emissions, reducing different pollutant emissions by mixing with coal with the help of some technologies
- Increasing terrestrial energy reserves
- To protect and increase the biological diversity living in the forest,
- Protecting the soil from erosion and pollution,
- To improve soil in the long term,
- Contributing to the water cycle,
- Creating a regional green belt,
- Avoid air pollution etc.

Today's world defines energy forests as “planted tree communities built to obtain firewood with trees that grow fast, do not require much maintenance, that grow on land that is not suitable for agriculture”. In addition, it seeks to consider these forests as a renewable energy source, to convert them into liquid and gaseous fuels, and to deliver them to cities and industry through different systems. At this point, landscape architecture should also consider these forests, which have important contributions both ecologically and functionally. Landscape architects should take care to establish energy forests in their design, planning or engineering work.

REFERENCES

Cısdık,İ. 2008.Türkiye'de enerji Tarımı Enerji Ormancılığı ve Agroforests Uygulamalarının Yaygınlaştırılması Yüksek Lisans Tezi, Ankara Üniversitesi Sosyal Bilimler Enstitüsü Sosyal Çevre Bilimleri Anabilim Dalı, Ankara.

Çevre ve Orman Bakanlığı,2006.Orman Genel Müdürlüğü, Orman Varlığımız, Orman Harita ve Fotogrametri Müdürlüğü, Ankara.

Günay,S.,2011.Türkiye'de Enerji Tarımı Amacıyla Ayçiçeği,Kanola ve Soya Fasulyesinin Yetiştirilmesi, *Doğu Coğrafya Dergisi,*Cilt:13, Sayı:20,Sayfa:163-166,Erzurum.

Güneş,G.,2011.Uluslar arası Ormanlar Yılı ve Enerji Ormanları,Atılım Üniversitesi *İz Dergisi*.Sayı:13,Sayfa:76-77,Ankara.

Saraçoğlu,N.,1997.*Ekoloji ve Çevre Dergisi*,Sayı:22.ZKÜ Orman Fakültesi Orman Mühendisliği Bölümü, Zonguldak.

TÇV,2006.Türkiye'nin Yenilenebilir Enerji Kaynakları,Türkiye Çevre Vakfı Yayını,Ankara.

URL 1. Ways to obtain heat and energy from biomass. https://energsustainsoc.biomedcentral.com/articles/10.1186/s13705-015-0062-8

UR 2. Turkey's primary energy resources production. https://www.mmo.org.tr/sites/default/files/gonderi_dosya_ekleri/TURKEY%20ENERGY%20OUTLOOK_%202020_%2813.7.2020_A%29.pdf

URL 3. Forest existence map of Turkey. https://www.researchgate.net/publication/329697920/figure/fig2/AS:779396608688162@1562834040717/Forest-cover-in-Turkey-OGM-2017-The-place-that-is-shown-in-a-circular-is-the-capital.png

URL 4. Forest percentage in Turkey by provinces. https://www.researchgate.net/publication/329697920/figure/fig3/AS:779396608696342@1562834040918/Forest-density-in-provinces-of-Turkey-OGM-2017-The-place-that-is-shown-in-a-circular.png

CHAPTER 8

DETERMINATION OF LAND USE CHANGES WITH OBIA METHOD AND SENTINEL IMAGES: MANAVGAT-GREENHOUSES SAMPLE

Agricultural Engineer Mesut ÇOŞLU[1]
Prof. Dr. Namık Kemal SÖNMEZ [2*]
Assoc. Prof. Dr. Serdar SELİM [3]

[1] Akdeniz University, Remote Sensing Application and Research Centre, Antalya, Turkey. E-mail: mesutcoslu@akdeniz.edu.tr. ORCID ID: 0000-0003-3952-6563

[2*] Akdeniz University, Faculty of Science, Department of Space Science and Technologies, Antalya, Turkey. E-mail: nksonmez@akdeniz.edu.tr ORCID ID: 0000-0001-6882-0599

[3] Akdeniz University, Faculty of Science, Department of Space Science and Technologies, Antalya, Turkey. E-mail: serdarselim@akdeniz.edu.tr ORCID ID: 0000-0002-5631-6253

INTRODUCTION

Remote sensing data is a technology that provides important data especially for the observation of land surfaces in the world. Being one of the most important data sources of this technology, satellites have an important place in terms of cost and time in the observation of large areas (Jensen and Cowen, 1999; Topaloğlu et al., 2016; Nguyen et al., 2020). Thanks to the sensors placed on these satellites for different purposes, it can provide data with different spatial, spectral, radiometric, and temporal resolution. In this context, satellites belonging to Landsat and Sentinel programs, which offer medium and high-resolution multispectral data, can be used in land use/land cover (LULC) determination studies, especially in recent years, as well as soil, water, and atmospheric studies. Successful classification results can be obtained in LULC change mapping studies from Sentinel 2 satellite images taken at different dates (Nguyen et al., 2020).

Greenhouse agriculture, which is one of the most effective ways to increase food production, has an important place especially in human nutrition. In this way, farmers will also be able to ensure sustainability in food supply for many years. Greenhouse agriculture can be done on all continents in the world, although it varies according to the economy and climate conditions of that region in terms of technology and technique used (Ardahanlıoğlu et al., 2020; Aznar-Sánchez et al., 2020).

Turkey is among the first four countries in the world in terms of greenhouse agriculture and it ranks second after Spain in Europe. According to data from the Ministry of Agriculture and Forestry (MoAF) in Turkey in 2019, 7.8 million tons to 31 million tons of vegetables were produced in the greenhouse. As of this date, Turkey's total greenhouse assets reached 790 thousand decares (da). In the last 10 years, the average greenhouse size has increased from 2 da to 4 da. Antalya province ranks first in greenhouse vegetable production with a share of 48%. According to the statistics of 2019, the greenhouse agricultural area of Antalya is 286522 da. (MoAF, 2021).

The correct determination of greenhouse production areas is very important, especially in terms of planning and yield estimation. However, it is difficult to determine greenhouses using traditional techniques. In this context, remote sensing data and analysis can be used. Whether the analyses used in the mapping of greenhouses are based on pixels or objects, successful results have been obtained. In addition to the analyses used, the increase of resolution in the data, the additional bands included in the datasets, features and indexes also contribute to this success (Koc-San, 2013; Coslu et al., 2016; Aguilar et al., 2016; Balcik et al., 2019; Aguilar et al., 2020).

Among these indexes, especially the plastic greenhouse index (PGI) and the retrogressive plastic greenhouse index (RPGI) gave high accuracy values in the analysis performed for the determination of plastic greenhouses (Yang et al., 2017; Balcik et al., 2019).

The purpose of this study is to monitor the change in greenhouse areas. In this context, a region within the borders of Manavgat district has been determined as a research area. The Sentinel 2 satellite, which also provides data with medium spatial resolution, was used in the study. The study consists of the basic stages of data collection and pre-processing, analysis, and evaluation. In the pre-processing phase of the study, geometric and atmospheric correction, layer stack and subset operations were carried out. In the analysis phase, the object-based classification method, which is more advantageous than pixel-based classification, was preferred. At the last stage of the study, evaluations were made according to the areal values obtained according to the results of the classification process.

1. MATERIAL AND METHOD

1.1. Study Area

In this study, a region within the boundaries of the district of Manavgat where the change in greenhouse areas is observed intensely was selected as the research area (Figure 1).

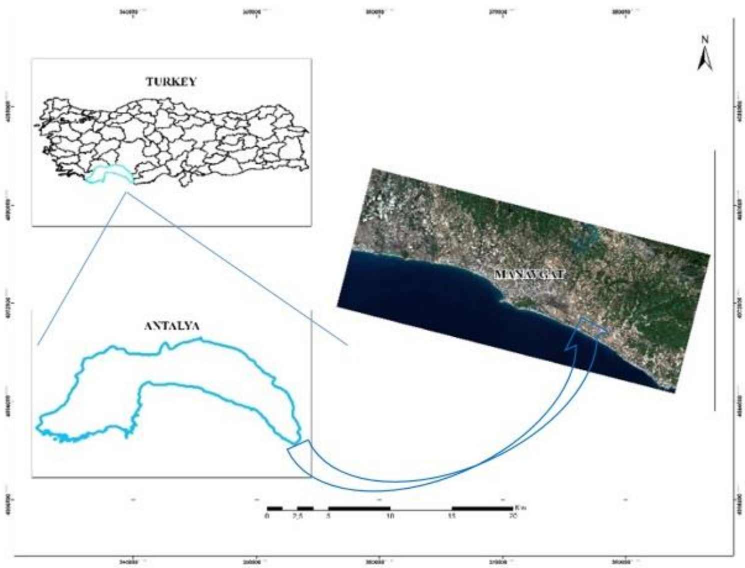


Figure 1. Study area

1.2 Data

The basic data set used in the study is Sentinel 2 satellite images. Sentinel 2 satellite has 13 spectral bands. Those with 10 m spatial resolution are B2 (490 nm), B3 (560 nm), B4 (665 nm) and B8 (842 nm), those with 20 m spatial resolution B5 (705 nm), B6 (740 nm), B7 (783 nm), B8a (865 nm), B11 (1610 nm) and B12 (2190 nm) and those with a spatial resolution of 60 m are B1 (443 nm), B9 (940 nm) and B10 (1375 nm) (ESA, 2021). In this study, 4 bands (blue, green, red, near infrared) with a spatial resolution of 10 m were used.

In addition, vector data of banana greenhouses obtained from Antalya Directorate of Provincial Agriculture and Forestry and supported by field survey results were used as a reference data in the study. These data were used in the evaluation of the polygons belonging to the greenhouse class to be obtained from the analysis phase of the study.

1.3 Method

The study consists of data collection, image pre-processing, object-based image analysis (OBIA) and evaluation (Figure 2).

Before all these processes, the study area was examined in detail and it was decided to create 5 classes. These are greenhouse areas, artificial surfaces, agricultural areas, forest and semi natural areas and water bodies.

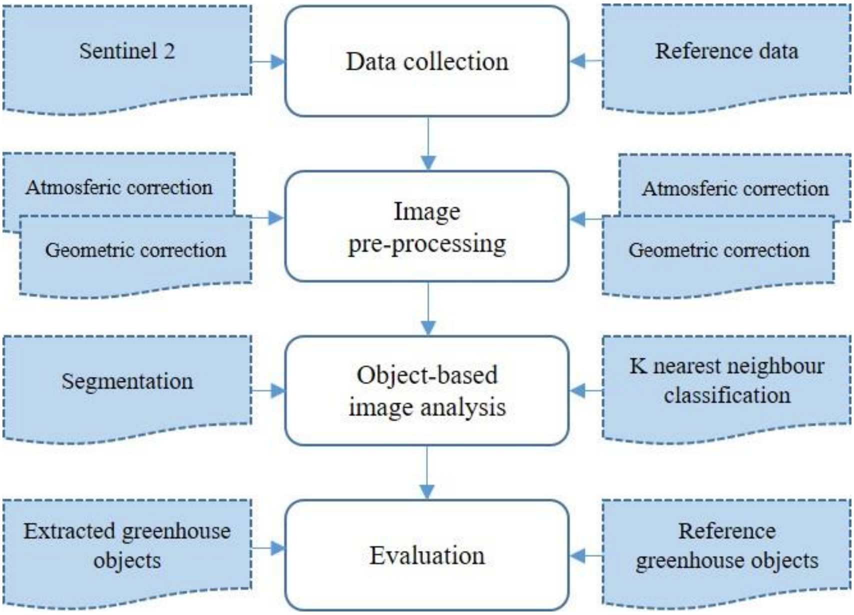


Figure 2. Flowchart

During the pre-processing phase of the study, atmospheric correction was applied to the November 2016 image. In addition, layer stack and subset operations were performed for both dated images at this stage. Geometric correction was performed for vector data showing reference banana greenhouses and all data sets were adjusted to the same projection and datum (Universal Transverse Mercator-UTM WGS 84 Zone 36).

In the image analysis phase of the study, the object-based classification process was carried out. This process consists of segmentation and classification sub-process steps. The segmentation process is an important sub-process for object-based classification. Because the quality of the segmentation process significantly affects the accuracy of the classification. In this study, the multi resolution segmentation (MRS) algorithm is used. In the MRS algorithm, there are parameters and criteria that the user must enter. These are the scale parameter and the shape and compactness criteria. In this study, the scale parameter, shape and compactness criteria were determined using a trial-and-error approach with visual analysis and interpretation.

After the segmentation process of the study, indexes, which are among the features to be used in classification, were calculated. Normalized difference vegetation index (NDVI), normalized difference water index (NDWI) and retrogressive plastic greenhouse index (RPGI) indexes are used in this study. The equations given below are used in the calculation of the indexes.

$$NDVI = \frac{NIR - RED}{NIR + RED} \qquad 1$$

$$NDWI = \frac{Green - NIR}{Green - NIR} \quad 2$$

$$RPGI = \frac{Blue}{1 - mean(Blue + Green + NIR)} \quad 3$$

In addition to these indexes, a total of 8 features (blue, green, red, NIR, brightness, NDVI, NDWI RPGI) were used in the classification of the images, including the average spectral and brightness characteristics of the 4 bands (Balcik et al., 2019).

KNN is one of the most basic machine learning algorithms in object-based classification, and it classifies the objects in the feature space according to the closest sample object. Here the "k" value is an integer and represents the number of nearest neighbours. In the classification carried out in this study, the value of "k" was entered as 1.

Finally, in the analysis phase of the study, the accuracy assessment of the classification processes was carried out. In this study, the error matrix was used to evaluate the accuracy. Two times as many validation objects as the number of samples belonging to each class were randomly selected to use in the accuracy assessment. At this stage, the reference dataset was also used visually.

At the last stage of the study, changes in number and the areal changes of the greenhouses in the area between 2016-2020 were evaluated using the extracted greenhouse objects and reference data.

2. RESULTS AND DISCUSSION

2.1 Pre-processing Results

The results of atmospheric correction, layer stack and subset operations performed in the pre-processing phase of the study are shown in the Figure 3.

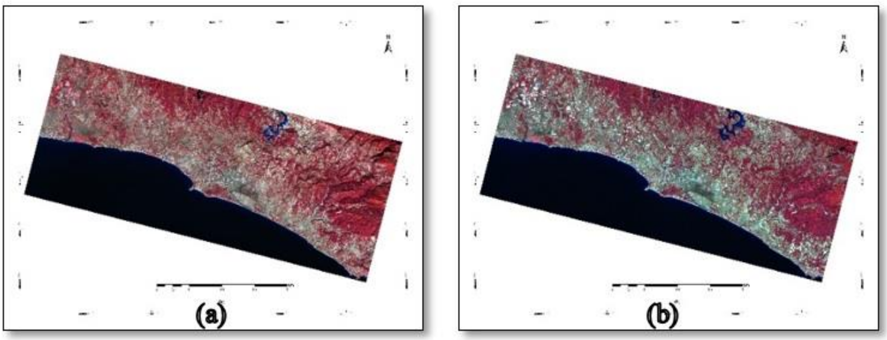


Figure 3. Pre-processing results, 2016 (a) and 2020 (b)

2.2 Classification Results

The result of the MRS algorithm used in this study is the result of the segmentation process of a zoomed region for images of both dates. In the Multiresolution segmentation algorithm, the scale parameter was 120, the shape and compactness criteria were determined as 0.2 and 0.5, respectively (Figure 4).

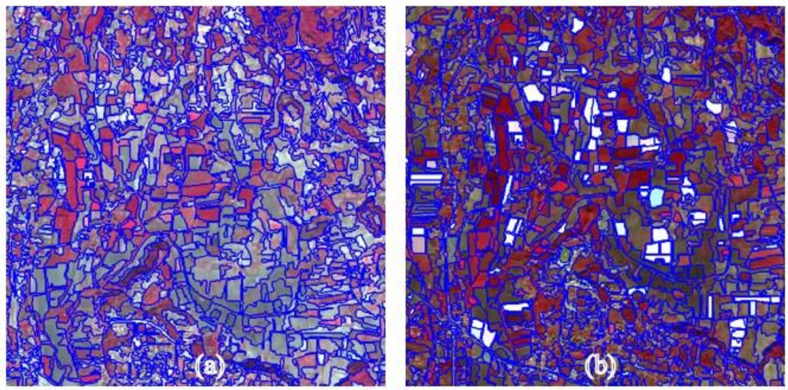


Figure 4. Segmentation results of the sample regions dated 2016 (a) and 2020 (b)

The accuracy values obtained because of the classification process of both dated Sentinel 2 satellite images are well above 80%. The overall accuracy obtained as a result of the object-based classification of the 2016 images of the study area is 85% and the kappa coefficient is 0.80 (Figure 5).

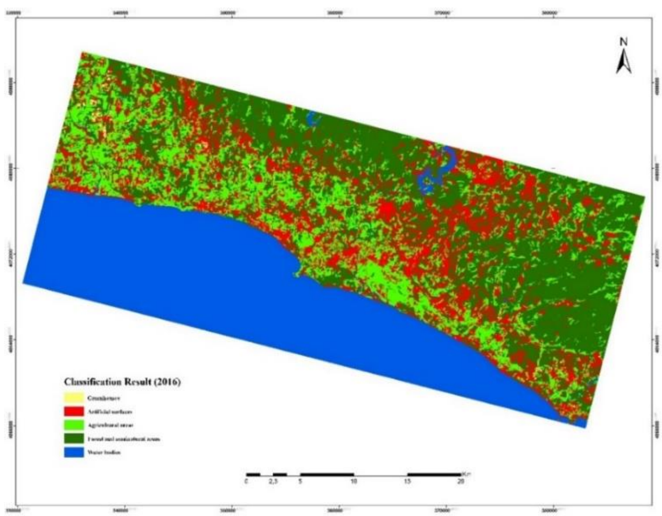


Figure 5. Object-based classification results in 2016

According to the 2016-year classification results of the study area; greenhouses are 339.93 hectares (ha), artificial surfaces are 20825.34 ha, agricultural areas are 21324.29 ha, forest and semi-natural areas are 39640.37 ha and water bodies are 39000.53 ha.

The overall accuracy obtained because of the 2020-year object-based classification of the study area is 87% and kappa coefficient 0.83 (Figure 6).

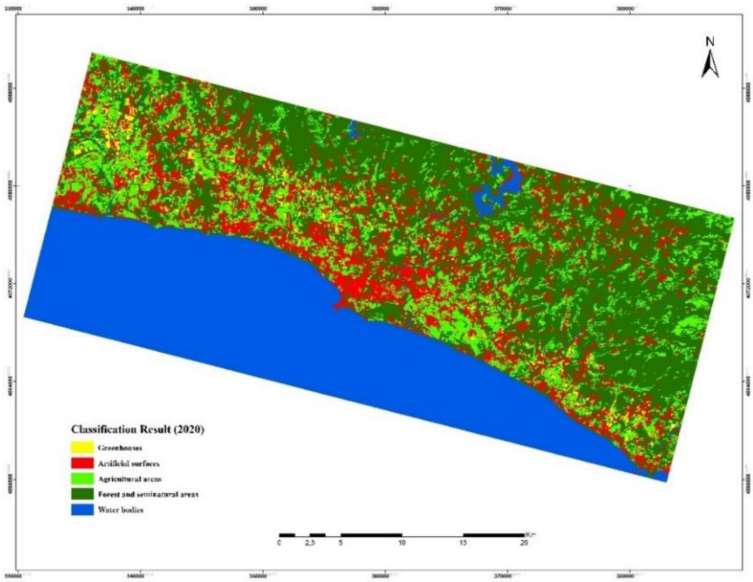


Figure 6. Object-based classification results in 2020

According to the 2020-year classification results of the study area; greenhouses are 1744.47 ha, artificial surfaces are 17727.88 ha, agricultural areas are 18393.22 ha, forest and semi-natural areas are 44306.60 ha and water bodies are 39189.95 ha.

Table 1. Object-based classification results in 2016 and 2020

Year	Greenhouse Areas (%)	Artificial Surfaces (%)	Agricultural Areas (%)	Forest and Seminatural Areas (%)	Water Bodies (%)
2016	0.28	17.19	17.60	32.73	32.20
2020	1.44	14.61	15.16	36.51	32.29

As a result of the 2016 object-based classification process, forest and semi-natural areas (32.73%) and water bodies (32.20%) cover the most area, while it was found that artificial surfaces (17.19%) and agricultural areas (17.60%) were close. The ratio of greenhouse areas in the total area in 2016 is 0.28%. According to the results of 2020, similar to 2016, forest and semi-natural areas (36.51%) and water bodies (32.29%) cover the most area, while it was again found that artificial surfaces (14.61%) and agricultural areas (15.16%) were close to each other. The ratio of greenhouse areas in the total area for the year 2020 is 1.44% (Table 1).

2.3 Greenhouse Change Detection

Since the aim of this study is to determine the temporal change in greenhouse areas, greenhouses, which are one of the five classes derived from the object-based classification process, have been transferred to the geographic information systems (GIS) separately from the other four classes.

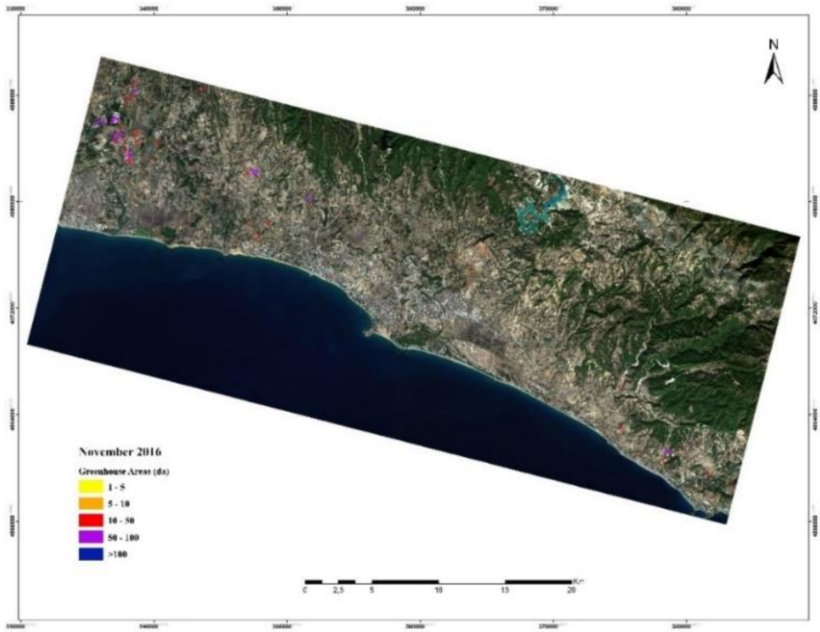


Figure 7. Greenhouse class categories in November 2016

Transfered greenhouse vector data categorized in five groups in the study area according to the analysis results of both dates are shown in Figure 7 and Figure 8. The greenhouse numbers and areal values of these data are given in Table 2.

Table 2. Number of greenhouses and their areal distribution in 2016-2020

Year	Number/Area	Greenhouses (da*)					Total
		1-5	5-10	10-50	50-100	>100	
2016	Number	150	66	68	17	-	301
	Area (da)	429,00	445,10	1446.30	1078.90	-	3399.30
2020	Number	349	206	369	51	22	997
	Area (da)	971.40	1447.30	8511.30	3224.70	3290.00	17444.70

**da=decare*

When Figure 7 and Table 1 are examined, the highest number of greenhouses is in the category of 1-5 da in the study area in 2016, while the minimum greenhouse is in the category of 50-100 da. According to the results of the object-based classification process, there are no greenhouses over 100 da in the area in 2016.

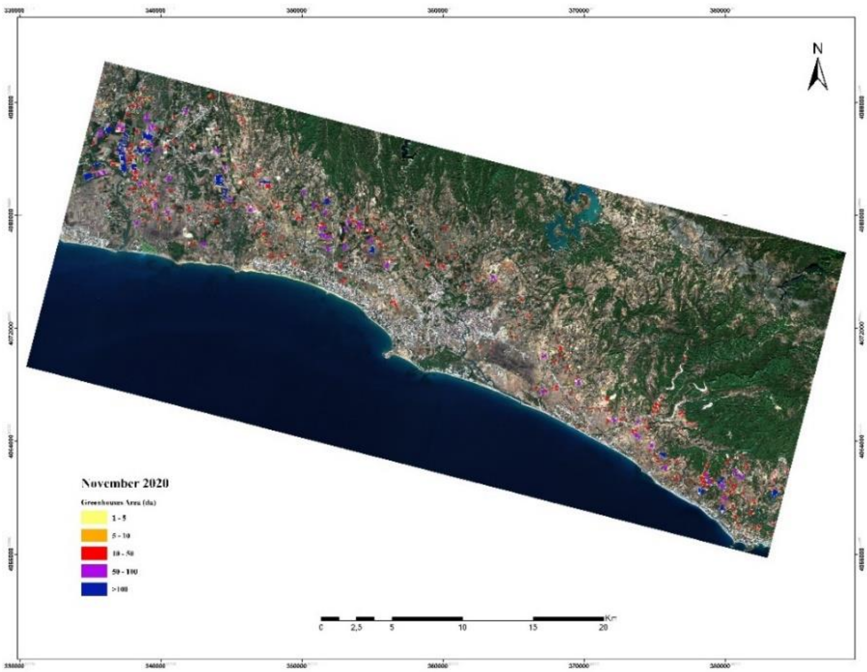


Figure 8. Greenhouse class categories in November 2020

As of 2020, it is seen that there is a significant increase in terms of greenhouse numbers and areal values. According to Figure 8 and Table 2, unlike 2016, the highest number of greenhouses is in the category of 10-50 da, both numerically and areal. Although it is numerically high in 2020, the lowest category in terms of areal is 1-5 da. In addition, it is seen that there are 22 greenhouses on 100 da in 2020. Although these 22 greenhouses are few, they are of a significant areal value.

Banana greenhouse areas used as reference data in the study were produced by Antalya Directorate of Provincial Agriculture and Forestry after being controlled by field surveys. There are 372 banana greenhouses obtained in this context. In this study, these banana greenhouses were also divided into 5 categories according to their areal values (Figure 9).

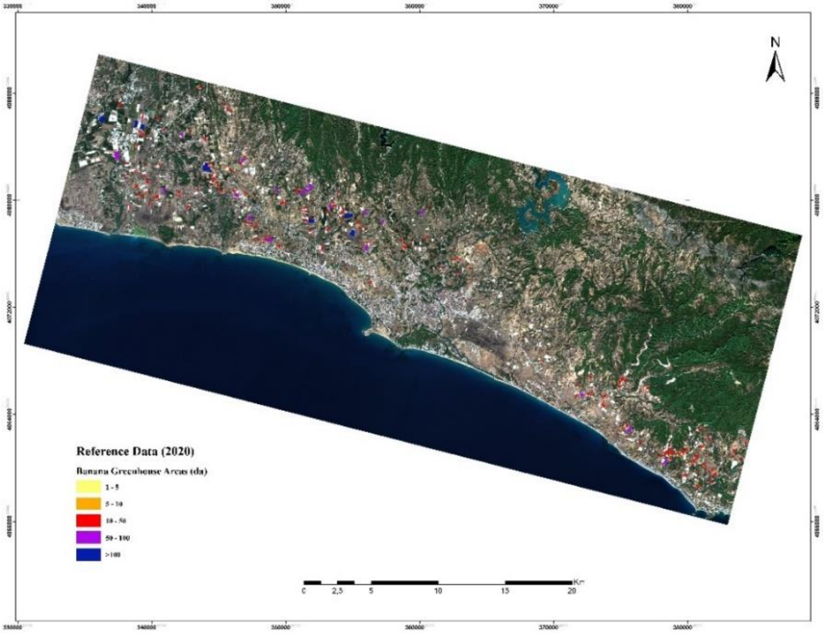


Figure 9. Greenhouse class categories in 2020 (reference data)

Most of the banana greenhouses in the study area are between 10-50 da (239 greenhouses and total 5810.93 da). Very few banana greenhouses in the area are above 100 da (9 greenhouses and total 1160.92 da) (Table 2).

Table 2. Reference banana greenhouses in 2020

Year	Number/Area	Greenhouses (da*)					Total
		1-5	5-10	10-50	50-100	>100	
2020	Number	25	75	239	24	9	372
	Area (da)	78.83	585.52	5810.93	1717.70	1160.92	9353.90

da=decare

Nguyen et al. (2020) found an overall accuracy between 63.9% to 80.3% for different classifiers in their LULC Mapping Using multitemporal Sentinel-2 imagery and four classification methods. Both Chaofan et al., (2016) using Landsat 8 images and Balcik et al., (2019) using Sentinel 2 images obtained an accuracy value of over 80% in greenhouse mapping studies. In the classification process of this study, NDVI, NDWI and RPGI were used as well as the average and brightness values of the 4 bands in the data set used by Balcik et al., (2019). As in the study conducted by Balcik et al. (2019), a classification result above 80% was obtained.

As a result of the object-based classification process of this study, it was determined that the extracted greenhouses especially replaced the annual agricultural production areas. As a result of the comparison of the greenhouse areas with the banana greenhouse areas, which are the reference data, considering the areal size of the greenhouses, it is evaluated that the new greenhouse areas are generally banana greenhouses (Figure 10).

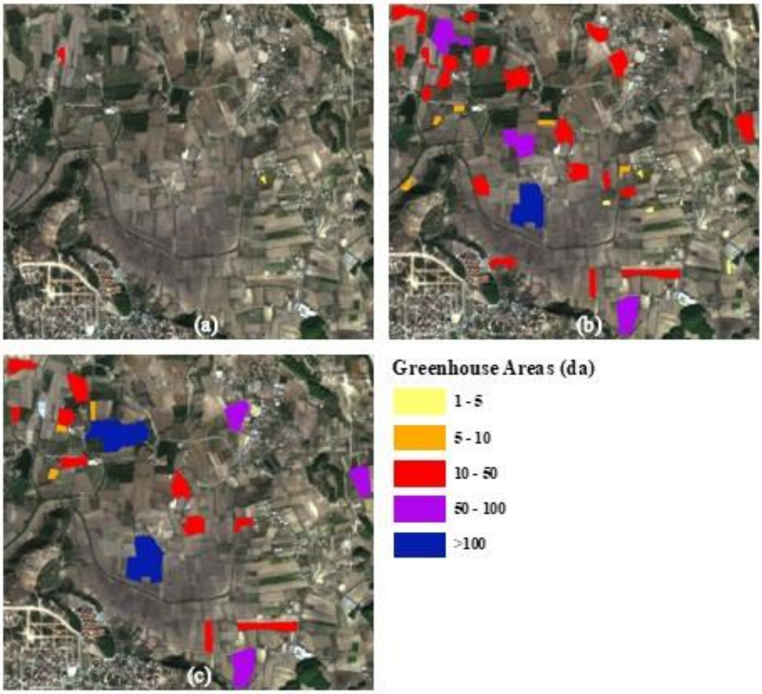


Figure 10. An example of change in greenhouse areas, 2016 (a); 2020 (b); reference data (c)

As a matter of fact, when the sample area in Figure 10 is examined in detail, it is seen that while almost no greenhouses were encountered in this region in 2016, large greenhouse enterprises between 5-100 decares were built in the region in the last four years and an intensive greenhouse increase occurred.

As it is known that bananas are cultivated in these areas according to the reference data sets obtained through land controls, it has been concluded that the greenhouse areas larger than 5 decares in the region in recent years are banana areas consisting of commercial enterprises.

3. CONCLUSION

In this study, it is aimed to determine the temporal change of greenhouses in the context of rural landscape planning. In this study carried out in the district boundaries of Manavgat, two different dated images of Sentinel 2 satellite were used. After the image pre-processing, object-based analysis and categorization of greenhouse areas, evaluations were made for all classes and especially about the change in the greenhouse areas during the four years period. The findings obtained from this study revealed that it is possible to monitor the change in greenhouse areas with Sentinel images and OBIA, which provide multispectral data in medium spatial resolution.

The use of remote sensing and GIS technologies is an important advantage in agricultural land use planning and monitoring of land cover change. Monitoring the temporal change in greenhouses will be an important reference in regional planning and will guide spatial planning. Monitoring the rapid increase in greenhouses and determining their change, especially in rural landscape planning in the Manavgat region, will play an important role in the agricultural development of the region.

Acknowledgments: The authors thank Republic of Turkey Ministry of Agriculture and Forestry Antalya Provincial Directorate and European Space Agency (ESA) for providing data of charge.

REFERENCES

Aguilar, M., Nemmaoui, A., Novelli, A., Aguilar, F., and García Lorca, A. (2016). Object-Based Greenhouse Mapping Using Very High-Resolution Satellite Data and Landsat 8 Time Series. Remote Sensing, 8(6), 513.

Aguilar, M. Á., Jiménez-Lao, R., Nemmaoui, A., Aguilar, F. J., Koc-San, D., Tarantino, E., and Chourak, M. (2020). Evaluation of the Consistency of Simultaneously Acquired Sentinel-2 and Landsat 8 Imagery on Plastic Covered Greenhouses. Remote Sensing, 12(12)

Ardahanlioğlu, Z. R., Selim, S., Karakuş, N., and Çınar, İ. (2020) GIS-Based Approach to Determine Suitable Settlement Areas Compatible with the Natural Environment. *Journal of Environmental Science and Management*, 23, 71-82.

Aznar-Sánchez, J. A., Velasco-Muñoz, J. F., López-Felices, B., and Román-Sánchez, I. M. (2020). An Analysis of Global Research Trends on Greenhouse Technology: Towards a Sustainable Agriculture. *International Journal of Environmental Research and Public Health*, 17(2), 664.

Balcik F., B., Senel, G., and Goksel, C. (2019). Greenhouse Mapping using Object Based Classification and Sentinel-2 Satellite Imagery. https://ieeexplore.ieee.org/stamp/stamp.jsp?arnumber=8820252. Accessed Date: 20.03.2021.

Chaofan, W., Jinsong, D., Ke, W., Ligang, M., and Tahmassebi, A., R., S. (2016). Object-based classification approach for greenhouse mapping using Landsat-8 imagery. Int J Agric and Biol Eng.; 9(1): 79-88.

Coslu, M., Sonmez, N. K., and Koc-San, D. (2016). Object-based greenhouse classification from high resolution satellite imagery: A case study Antalya-Turkey. Int. Arch. Photogramm. Remote Sens. Spatial Inf. Sci., XLI-B7, 183–187.

ESA. 2021. Sentinel 2 Spatial Resolution. https://sentinels.copernicus.eu/web/sentinel/userguides/sentinel2msi/resolutions/ Accessed Date: 01.04.2021.

Jensen, J., R. and Cowen, D., C. (1999). Remote sensing of urban/suburban infrastructure and socioeconomic attributes. Photogramm. Eng. Remote Sens., 65, 611–622.

Koc-San, D. (2013). Evaluation of different classification techniques for the detection of glass and plastic greenhouses from WorldView-2 satellite imagery. J. Appl. Remote Sens., 7.

MoAF. (2021). Örtüaltı yetiştiricilik. https://www.tarimorman.gov.tr/Konular/Bitkisel-Uretim/Tarla-Ve-Bahce-Bitkileri/Ortu-Alti-Yetistiricilik Accessed Date: 01.04.2021.

Nguyen, H. T. T., Doan, T. M., Tomppo, E., and McRoberts, R. E. (2020). Land Use/Land Cover Mapping Using Multitemporal Sentinel-2 Imagery and Four Classification Methods-A Case Study from Dak Nong, Vietnam. Remote Sensing, 12(9), 1367.

Topaloğlu, H., R., Sertel, E., and Musaoğlu, N. (2016). Assessment of classification accuracies of SENTINEL-2 and LANDSAT-8 data for land cover/use mapping. Int. Arch. Photogramm. Remote Sens. Spat. Inf. Sci., XLI-B8, 1055–1059.

Yang, D., Chen, J., Zhou, Y., Chen, X., Chen, X. and Cao, X. (2017). Mapping plastic greenhouse with medium spatial resolution satellite data: Development of a new spectral index", ISPRS J. Photogramm. Remote Sens., vol. 128, pp. 47-60.

CHAPTER 9

THE SCENARIO BASED LANDSCAPE ECOLOGICAL RISK MANAGEMENT MODEL FOR LAKE GALA NATIONAL PARK

Dr. Gökhan BALIK [1*]
Prof. Dr. Bahar TÜRKYILMAZ[2]

[1*] Trakya University, Faculty of Architecture, Department of Landscape Architecture, Edirne, Turkey. E-mail: gokhanbalik@trakya.edu.tr ORCID ID: 0000-0003-0155-6118
[2] Ege University, Faculty of Agriculture, Department of Landscape Architecture, İzmir, Turkey. E-mail: bahar.turkyilmaz.tahta@ege.edu.tr ORCID ID: 0000-0001-8125-9759

INTRODUCTION

Wetlands are one of the world's richest ecosystems and most productive landscapes with ecosystem services, biodiversity-hosting services, carbon storing and other benefits (Chen et al., 2020; Keddy et al., 2009; Meyer et al., 2003). Nevertheless, 30%–90% of the world's wetlands have already been destroyed or strongly modified in many countries (Amenu and Mamo, 2018). In Turkey, many wetlands protected under national legislation and international agreements are under pressure due to natural and cultural threats. The determined conservation status and strategies by legislation and plans cannot be adhered on the application basis (WWF, 2011). The conservation and management decisions that have come up against the benefits from the wetlands of the local people have forced them. For this reason it has become clear that the conservation-use balance of current conservation planning and management approaches becomes compulsory. Besides, considering the future, there are risks that can cause harm to the ecosystems if not avoided. A good landscape architect realizes the future for planning. Thus, s/he can estimate future environmental risks and results and take decisions on thataway. From here, this chapter proposes a scenario-based landscape ecological risk assessment model for Lake Gala National Park where the same problems are experienced.

1. RISK ASSESSMENT

Risk is the chance of harm. The term 'risk' contains both the probability and severeness of consequences of events. Therefore, a threat can exist without a risk. Risk manifests itself when there is a potential source that has the potential to effect other factors. 3 types of risk assessments are identified: qualitative, quantitative and semi-quantitative risk assessments. Qualitative risk assessment methods offer a detailed, simple and rapid assessment. They are useful when numerical data are inadequate or unavailable, resources such as time and budget are limited. Quantitative methods are the most complex methods that require mathematical formulas and calculations. Many specialists from different fields discussed these methods. Semi-quantitative assessment can be used when the quantification of risk is difficult and simultaneously, a qualitative interpretation is too subjective. The combination of the two models can be a solution in some cases, combining the specific advantages of each and decreasing their disadvantages. Semi-quantitative methods are used to define the relative risk scale on categories such as ‘low-medium-high-very high" and ‘0-10’(Radu, 2009).

2. ECOLOGICAL RISKS AND ASSESSMENT

Wang et al., 2020, underlines the definition of the ecological risk: “Ecological risk is the risk that ecosystems and their components are exposed to disturbances from human activities and environmental change”. Ecological risk subjects started in the 1970s with chemical toxic effects on ecosystems and expanded from chemical effects on environmental and ecological events related to the impact of human activities on the ecological environment (Wang et al., 2020). Ecological risks have 2 properties: damage and uncertainty. Damage has the potential to effect all organisms containing flora, fauna and humans irreversibly. Uncertainty comes from coincidences, synergy or cumulative effects of risks and it is difficult to predict (Xu et al., 2004).

Wu et al., 2021, outlines the definition of the ecological risk assessment method: “Ecological risk assessment is a method system to predict the possibility of various risk sources to the ecosystem and tolerability of the ecosystem, which also is a quantitative basis for ecological risk management and decision-making”.

3. LANDSCAPE ECOLOGICAL RISK ASSESSMENT

Landscape ecological risk assessment is an important ecological measure for landscape protection, biodiversity conservation, soil-water retention, ecological balance achievement, conservation-use / nature-human balance achievement, visitor management, early warning of adverse environmental or ecological effects and decision making for landscape management (Chen et al., 2020; Wang et al., 2020; Luo et al., 2018; Gong et al., 2015; USEPA, 1992).

The research on ecological risk assessment increased over time and this subject divided into many branches according to the fields of research. One of the major branches of ecological risks is the ‘landscape ecological risk’ (LER) (Lin et al., 2019). Landscape ecological risk topic is popular in recent years (Wang et al., 2020; Lin et al., 2019).

Wu et al., 2021, outlines landscape ecological risk and assessment as: “Landscape ecological risk is the adverse effect of the interaction between landscape pattern and ecological process. With the fast development of landscape ecology theory, the application of GIS and RS technology in land management, environmental assessment, spatial pattern analysis and other fields makes it possible to quantitatively assess the ecological risk from the perspective of landscape, so landscape ecological risk assessment is becoming an attractive direction of regional cases. As a branch of ecological risk assessment, landscape ecological risk assessment emphasizes the analysis, assessment and comprehensive characterization of various stress factors caused by different risk sources on a regional scale."

Many researchers from different fields contribute to researches on different branches of ecological risk assessment such as: Chemical Ecological Risk Assessment (Berni et al., 2021; Fural et al., 2020), Regional Ecological Risk Assessment (Xu et al., 2004; Baoyan and Xuelin, 2000), System Based Ecological Risk Assessment (Chen et al., 2013), Scenario Based Ecological Risk Assessment (Darvishi et al., 2020; Fu et al., 2020; Cao et al., 2019), Wetland Ecological Risk Assessment (Li et al., 2020a; Rico et al., 2015; Malekmohammadi and Blouchi, 2014; Hart et al., 2003) and lastly Landscape Ecological Risk Assessment (Gong et al., 2021; Wang et al., 2021; EEA, 2007; Li et al., 2020b).

This chapter reveals that methodologies used in researches depend on: 1. The characteristics and size of the research area (terrestrial, wetland, forest land, region, subregion, landscape), 2. Collectible data, 3. Quantitative, semi-quantitative or qualitative risk assessments, 4.

Statistical methods (Markov chain, AHP, Linear regression...), 5. The area of expertise (landscape architecture, natural sciences, engineering, chemistry or interdisciplinary). It is impossible to find the perfect method for risk assessment. However, the best way is to define, evaluate and calculate the situations that include risks depending on the activities (Radu, 2009).

4. RESEARCH AREA and DATA SOURCE

4.1. Research Area

Lake Gala National Park is in Edirne province of Thrace region in Turkey (Figure 1). Meriç River and its tributaries are located at the west of the National Park, which form the border of Bulgaria and Greece.

Figure 1. The Research Area: The Location and View (HGK, 2021)

Lake Gala National Park, which has a surface area of 6.087 hectares, is located between 40 ° 46'06.79"K - 26 ° 11'07.63"D coordinates. According to Article 3 of the National Parks Law No. 2873, it was declared a National Park in 2005 with the decision of the Council of Ministers. Lake Gala consists of two parts, the Great Gala and the Small

Gala. The Great and Small Gala Lakes, Sığırcı Lake, Pamuklu Lake and Meriç River act as a whole wetland. The total amount of these lakes is 1,130 ha. 51.28% of the National Park area consists of maquis, 2.43% of agricultural areas, 1.78% of meadow areas, 33.78% of swamp areas and 10.73% of lake areas (DKMP, 2010). Lake Gala National Park is highly valuable in terms of; 1. Being an A-class wetland with 3 Ramsar criteria (4-5-6), with hosting ecologically important areas that must be protected, 2. Being in a transboundary Maritza Delta landscape in between Turkey, Greece and Bulgaria, 3. Including both terrestrial (3,374 ha) and aquatic (2,713 ha) ecosystems, 4. Hosting hundreds of ecologically important and endemic flora and fauna species (plants, fish and birds) that are under the protection catagories of IUCN and Bern Convention on the Conservation of European Wildlife, 5. Activities such as ecotourism, bird watching, picnics, camping, trekking, canoeing, fishing, grazing, farming, fishing, hunting, apiculture, harvesting reeds, mining, collecting and draining water.

4.2. Data Sources

This research gathered and evaluated these data resources: 22 basemaps of the research area (related with: temperature, rain, topography, soil, hydrogeology, hydrology, ecosystem, forestry, bird breeding –feeding – sheltering, vegetation, habitat, land cover, land use, legal protection districts, governing districts), regulatory documents, Google Earth view of 18.04.2016, ArcGIS basemap of 2016 and 2017, observation notes and original pictures from field research, opinions of The Ministry of Forestry and Water Affairs on AHP and ministerial reports.

5. METHOD: Scenario Based Landscape Ecological Risk Management Model

This chapter reveals the semi-quantitative, scenario-based landscape ecological risk management model that is developed for Lake Gala National Park. The proposed model consists of 7 stages (Figure 2). This model is based on the wetland ecological risk assessment method used by Malekmohammadi and Blouchi, 2014, which is the most suitable ecological risk assessment method for the area and data. It was adapted and developed according to the characteristics of the landscape, the data obtained and the landscape architecture perspective, and converted into a scenario-based model with the suggestion of public participation.

In this method, ecological risk factors are selected only from the uses, not from the natural processes. Because of field researches, expert opinions and other inventory data, we observed that natural factors (nature) have very little effect than cultural factors (uses). Natural factors affect cultural factors cumulatively. Thus, this chapter concludes that an urgent intervention to cultural effects is necessary for the future of the National Park. Likewise, it is predicted that the method will become clearer when ecological risk factors are reduced to only uses.

In this method, landscape ecological risk assessment maps were created for each type of use, and finally, "Lake Gala National Park Landscape Ecological Risk Assessment Map" was created by combining all these maps with the GIS and Analytical Hierarchy Process (AHP) statistical method. In this map, it is understood how often and how severely ecological risks affect which parts of the National Park. Based on this, 2 scenarios were created, mapped, compared with the current situation and evaluated to test the new suggestions and their effectiveness.

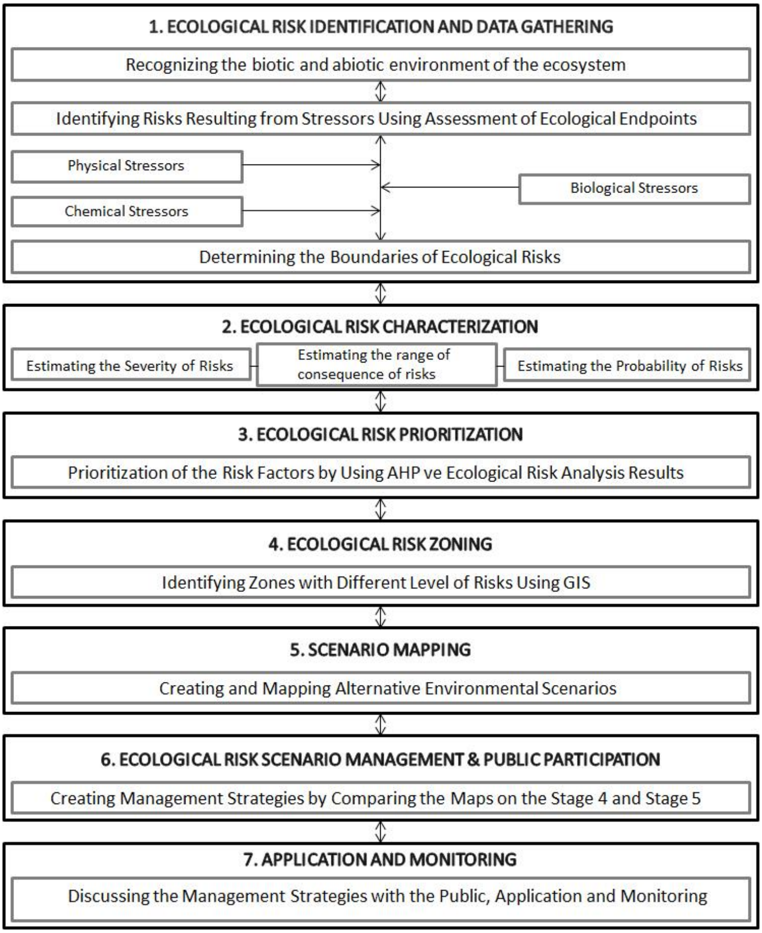


Figure 2. Method Flowchart (Altered from Malekmohammadi and Blouchi, 2014)

The results are discussed and finalized with public participation. At the end, the final management plan is applied and monitored. Due to time, page and possibility constraints, this chapter only suggests public participation, application and monitoring sections. These sections exist because, public participation and monitoring stages are fundamental for an effective management system. The stages of model are:

5.1. Ecological Risk Identification and Data Gathering

This step includes gathering all data: regulations, ministrative documents, maps, field research data. First, the study area landscape is defined with its boundaries. It is necessary to determine the uses that affect and create stress in and around the defined landscape. These sources of stress may be causing physical, chemical or biological stress. It is necessary to determine the ecological endpoints of the uses that cause stress in or around the research areas (Malekmohammadi and Blouchi, 2014).

5.2. Ecological Risk Characterization

Risks are analyzed according to their severity, probability and consequence. *Risk = Severity of Risk x Probability of Risk x Range of Consequences of Risk.* This step creates the classification of ecological risk severity, probability and consequence from "very low" to "very high" from various literature, engineering decisions and expert evaluations. This step scores the identified environmental risks according to their severity by applying the evaluation results of each potential risk. The expected results are identified through the assessment of ecological endpoints. Classification and scoring of the severity of ecological risks are improved by the cumulative impact assessment in the wetland. The impact area scoring assessment of each ecological risk are related to the size of the area affected by the risks. After the severity, consequences and probabilities of ecological risks are evaluated and calculated separately, the above-mentioned risk equation is applied and the result score is interpreted by looking at the relevant table. The maximum is 125 points (Malekmohammadi and Blouchi, 2014).

5.3. Ecological Risk Prioritization

Ecological risks are prioritized according to their importance. Prioritization is done according to the severity, consequence and probability of ecological risks. These criteria should be evaluated according to their degree of importance and impact. In order to determine the risk levels, risks and effective indicators are prioritized. Weight factors of ecological risks arising from determined uses are determined by experts and evaluated by the Analytic Hierarchy Process (AHP) method among Multiple Criteria Decision Making (MCDM) methods. The result is a weight factor for each ecological risk in percentage (Malekmohammadi and Blouchi, 2014).

5.4. Ecological Risk Zoning

All ecological risk factors should be spatially modeled. It should be displayed on the map as point, line, polygon or raster model. Ecological risks in and around the research area, calculated in previous steps, are mapped in this section. Point or linear areas are represented by buffer zones. With the representations on the map, the weights and scores are superimposed with the "Weighted Linear Combination" (WLC) statistical method in the GIS software. Among the "Multi-Criteria Evaluation" (MCE) methods, WLC is one of the most used methods in field suitability analysis. WLC analysis is based on this equation: $S = \Sigma WiXi$. 'S' in the equation indicates the zoned map of the landscape, Wi is the weight of the 'i' layer taken from the AHP method, and Xi indicates the standard raster layer 'i'. According to the gradual zoning map, areas containing risks at different levels are identified (Malekmohammadi and Blouchi, 2014).

5.5. Scenario Mapping

Estimated maps of the developed scenarios are created with the same method of previous steps. The created maps are compared and analyzed together. According to the results, resources and all data, new scenarios can be created or appropriate scenarios can be selected for the next step.

5.6. Ecological Risk Scenario Management and Public Participation

The landscape ecological risk map of existing situation is compared and evaluated with the scenario maps. Management and implementation principles are determined based on the results. The ecological scenario management results and their importance are shared with the public. If it is necessary, it is possible to turn back to the previous step to create more scenarios. Then, as a result of the public opinion and discussion section, the management principles are determined. Protection-usage balance is decided in this section. This step is for providing landscape management strategies by using ecosystem-based approach.

5.7. Application and Monitoring

The agreed landscape ecological risk management plan is implemented and monitored and supervised in real time by GIS support, various cameras and national park rangers. In the event that change conditions in the future or future data are found, it is possible to go back to stage 5, the management plan is revised and the implementation and observation continue.

6. RESULTS

6.1. Simulation of the Model

6.1.1. Ecological risk identification and data gathering

Ecological risk assessment was evaluated on 11 basic landscape usage types, in other words risk factors (Table 1).

6.1.2. Ecological risk characterization

For the first step, the ecological risks are scored and classified according to the Table 2. The results are shown in Table 3. For the second step, the ecological risks are scored and classified according to the exposed areas (Table 4). The results are shown in Table 5. For the third step, the ecological risks are scored and classified according to the probability (Table 6). The results are shown in Table 7.

Table 1. Characteristics of the Risk Factors

Risk factor	Harmful potential effects	Receivers	Range of consequences
1. Water suction from the lake	-Decrease in water level	-All aquatic life	-All of the wetland
	-Increase in salinity		
	-Increase in water temperature		
	-Death of fish		
	-Disruption of ecological balance of aquatic life		
2. Agricultural water discharge	-Nitrogen, nitrate and phosphate pollution	-All organisms including humans	-All of the wetland
	-Eutrophication		
	-Increase of pH		
	-Threatens the aquatic and bird life		
	-Causes soil pollution		
	-Causes underground water pollution		
3. Pressure of agricultural use	-Abiotic factor interchange between the agricultural land and wetland	-All organisms	-Large part of the wetland
	-Agriculture is one of the main reasons of deterioration of the natural structure at some areas		
	-Excessive water transfer from wetlands to farms and back transfering polluted water to wetland		-Northern part of the agricultural areas
4. Grazing	-One of main reasons that converted forest lands into degraded forest lands	-Aquatic and terrestrial vegetation	-Terrestrial zones
	-Among the factors that cause deterioration of the natural structure in certain regions	-Fauna of the terrestrial habitats	-Wetland
	-Illegal vegetation destruction for pasture areas		
	-Causes erosion		
	-Vegetation destruction by grazing new tillers especially after tree cuttings		
5. Fishing	-Change of aquatic ecosystem balance	-All aquatic life	-Entire wetland
6. Hunting	-Change of bird ecosystem balance	-Birds and other terrestrial life	-Entire wetland
	-Decrease of bird populations		-Terrestrial zones
	-Noise pollution		
7. Sets and roads	-The road in the middle of the wetland prevents the access of wetland feeding surface waters	-Flora ve fauna on the buffer zones of sets and roads	-Buffer zone of the sets
	-Death of birds and aimals, damage of plants due to noise and air pollutions caused by vehicles passing through Cimra River	-All fauna and flora of the wetland	-All of the wetland
	-Lead accumulation in crops of agricultural areas around the highway on Cimra Set		
8. Drainage channels	-IP-1 Channel causes sedimantation in the lake	-All organisms	-All of the wetland
	-Solid materials in the channels fill the lake and cause reverse water flow in the channels		
	-The water from Yeni Karpuzlu waste water treatment facility flows to Lake Pamuklu without quality control		
	-Polluted water from Maritza river flows to the lake by channels		
9. Reed burning	-Disrupting the aquatic ecosystem	-Wetland ecosystem	-Entire wetland
	-Dismissing birds	-Especially the reed vegetation and birds	-Terrestrial zones near the reed fields
	-Burning of bird and other animal shelter habitats		
	-Risk of fire spreading to other areas		
10. Tree cutting	-One of the reasons why 85% of the forests turn into degraded forests	-Forest ecosystem life	-Terrestrial zones
	-Changes the forest ecosystem		
	-Causes erosion		
	-Destroys red pine trees		
	-Illegal pasturage area constructions by cutting trees		
11. Mining	-Causes noise, air and soil pollutions	-Fauna around the mines	-Terrestrial areas nearby
	-Explosions used for mining causes ground shake and scare the animals		

Table 2. The Scoring and Classification of Ecological Risk Factor magnitudes (Malekmohammadi and Blouchi, 2014)

Expected consequence	Scores range	Classification
Destroying the integrity and existance (5)	15-13	Very high (5)
Changes in the hydrological balance and regime (4)	12-10	High (4)
Disruption of the biological balances (3)	9-6	Moderate (3)
Changes in physical and chemical parameters (2)	5-3	Low (2)
Disruption of the biogeochemical cycles (1)	<3	Very low (1)

Table 3. The Scoring and Classification of Ecological Risk Factor magnitudes

Risk Factor	Score range	Classification
Water suction from the lake	15	5 (Very high)
Agricultural water discharge	10	4 (High)
Pressure of agricultural use	15	5 (Very high)
Grazing	15	5 (Very high)
Fishing	6	3 (Moderate)
Hunting	6	3 (Moderate)
Sets and roads	10	4 (High)
Drainage channels	10	4 (High)
Reed burning	6	3 (Moderate)
Tree cutting	15	5 (Very high)
Mining	6	3 (Moderate)

Table 4. The Scoring and Classification of Exposed Areas from Ecological Risk Factors (Malekmohammadi and Blouchi, 2014)

Wetland exposed area (portion of total area)	Classification
All of the wetland and the surrounding ecosystems	Very high (5)
Three quarter (¾)	High (4)
Half (½)	Moderate (3)
One quarter (¼)	Low (2)
Less than one quarter (¼)	Very low (1)

For the fourth and final stage, the risk equation is calculated for all risk factors with the equation: *Risk= Risk severity x Risk probability x Range of consequences of risk*. Accordingly, the corresponding points are matched from Table 8 and the results are shown in Table 9.

Table 5. The Scoring and Classification of Exposed Areas from Risk Factors

Risk Factor	Classification
Water suction from the lake	3 (Moderate)
Agricultural water discharge	4 (High)
Pressure of agricultural use	3 (Moderate)
Grazing	4 (High)
Fishing	2 (Low)
Hunting	4 (High)
Sets and roads	3 (Moderate)
Drainage channels	3 (Moderate)
Reed burning	4 (High)
Tree cutting	3 (Moderate)
Mining	3 (Moderate)

Table 6. The Scoring and Classification of Ecological Risk Probability (Malekmohammadi and Blouchi, 2014)

Expected probability	The likehood of the consequence	Classification
Certain (risks occur continuously)	Very likely	Very high (5)
Common (risks occur usually)	Greater than 50%	High (4)
Possible (risks may occur from existing risks)	Equal to 50%	Moderate (3)
Likely, but are low	Unlikely under normal conditions	Low (2)
Likely, but are very low	Impossible or remote under normal conditions	Very low (1)

Table 7. The Scoring and Classification for the Risk Factors (Malekmohammadi and Blouchi, 2014)

Risk Factor	Classification
Water suction from the lake	5 (Very High)
Agricultural water discharge	5 (Very High)
Pressure of agricultural use	5 (Very High)
Grazing	5 (Very High)
Fishing	5 (Very High)
Hunting	5 (Very High)
Sets and roads	4 (High)
Drainage channels	4 (High)
Reed burning	4 (High)
Tree cutting	5 (Very High)
Mining	4 (High)

Table 8. The Classification and Description of Risk Factors (Malekmohammadi and Blouchi, 2014)

Risk Factor	Classification	Description
125-101	Very high	Unacceptable
100-75	High	Unacceptable
74-50	Moderate	Acceptable with conditional control
49-26	Low	Acceptable
<26	Very low	Negligible

Table 9. The Classification and Description for the Research Area (Malekmohammadi and Blouchi, 2014)

Risk Factor	Classification	Description
Water suction from the lake	75 (High)	Unacceptable
Agricultural water discharge	80 (High)	Unacceptable
Pressure of agricultural use	75 (High)	Unacceptable
Grazing	100 (High)	Unacceptable
Fishing	30 (Low)	Acceptable
Hunting	60 (Moderate)	Acceptable with conditional control
Sets and roads	48 (Low)	Acceptable
Drainage channels	48 (Low)	Acceptable
Reed burning	48 (Low)	Acceptable
Tree cutting	75 (High)	Unacceptable
Mining	36 (Low)	Acceptable

These results are the average effects of ecological risk factors within the entire classification limit of Lake Gala National Park. When each factor is considered within its own region, the severity of each risk factor has a regional effect classification of "medium, high and very high", as stated in the calculation of the severity of ecological risks. For this reason, the aforementioned 11 risk factors are included in the evaluation and results are stated accordingly.

6.1.3. Ecological risk prioritization

Ecological risk factors are prioritized by AHP statistical method. Ecological risk factors are compared and graded by weight with each other at this step. The scoring stage of AHP was actualized within the expert opinions of Turkish Republic Regional Directorate of the Ministry of Forestry and Water Affairs, Edirne Branch Directorate and through Business Performance Management Singapore website (BPMS, 2021). According to the AHP method, the risk factors from the highest to the lowest priorities of risk are listed as follows with their significance ranks (Figure 3):

Priorities

These are the resulting weights for the criteria based on your pairwise comparisons

	Category	Priority	Rank
1	Water Suction	6.6%	8
2	Agr Water Disch	7.2%	7
3	Press of Agr Use	1.9%	9
4	Grazing	16.2%	2
5	Fishing	12.6%	3
6	Hunting	20.6%	1
7	Sets and Roads	10.0%	6
8	Drainage Chnls	10.4%	5
9	Reed Burning	1.7%	10
10	Tree Cutting	11.5%	4
11	Mining	1.2%	11

Number of comparisons = 55
Consistency Ratio CR = 9.0%

Decision Matrix

The resulting weights are based on the principal eigenvector of the decision matrix

	1	2	3	4	5	6	7	8	9	10	11
1	1	1.00	5.00	0.20	0.50	0.12	0.50	0.33	9.00	1.00	9.00
2	1.00	1	5.00	0.50	0.50	0.50	0.33	0.25	8.00	1.00	8.00
3	0.20	0.20	1	0.20	0.17	0.17	0.20	0.20	1.00	0.14	2.00
4	5.00	2.00	5.00	1	1.00	3.00	1.00	1.00	6.00	1.00	8.00
5	2.00	2.00	6.00	1.00	1	1.00	2.00	2.00	4.00	1.00	7.00
6	8.00	2.00	6.00	0.33	1.00	1	5.00	5.00	7.00	1.00	9.00
7	2.00	3.00	5.00	1.00	0.50	0.20	1	1.00	7.00	1.00	7.00
8	3.00	4.00	5.00	1.00	0.50	0.20	1.00	1	5.00	0.50	7.00
9	0.11	0.12	1.00	0.17	0.25	0.14	0.14	0.20	1	0.12	2.00
10	1.00	1.00	7.00	1.00	1.00	1.00	1.00	2.00	8.00	1	8.00
11	0.11	0.12	0.50	0.12	0.14	0.11	0.14	0.14	0.50	0.12	1

Principal eigen value = 12.356
Eigenvector solution: 7 iterations, delta = 5.8E-8

Figure 3: AHP Calculation (Calculated Using (BPMS, 2021))

As a result, the weighted risk-level scores are calculated by multiplying the risk-level scores with the score of the importance weight in AHP. Consequently, the risk-ranking numbers are listed in Table 10.

Table 10. Lake Gala National Park, Calculation of Ecological Risk Prioritization, Final Chart

Risk Factor	Severity	Range of consequence	Probability	Risk level	Importance weight in AHP	Weighted risk	Risk ranking number
Grazing	5	4	5	100	0.162	16.2	1
Hunting	3	4	5	60	0.206	12.36	2
Tree cutting	5	3	5	75	0.115	8.625	3
Agricultural water discharge	4	4	5	80	0.072	5.76	4
Drainage channels	4	3	4	48	0.104	4.992	5
Water suction from the lake	5	3	5	75	0.066	4.95	6
Sets and roads	4	3	4	48	0.1	4.8	7
Fishing	3	2	5	30	0.126	3.78	8
Pressure of agricultural use	5	3	5	75	0.019	1.425	9
Reed burning	3	4	4	48	0.017	0.816	10
Mining	3	3	4	36	0.012	0.432	11

6.1.4. Ecological risk zoning

In this section, ecological zoning maps for 11 risk factors are created separately (Figure 4):

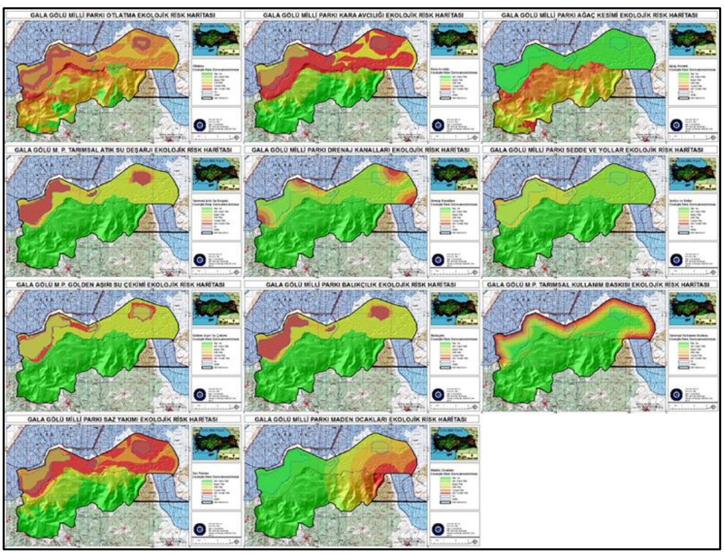


Figure 4: Zoning Maps of the 11 Ecological Risk Factors

- ***Lake Gala National Park Landscape Ecological Risk Assessment Map***

11 ecological maps were superimposed by multiplying with weight points given in the chart and as a result, Lake Gala National Park Landscape Ecological Risk Assessment Map was created (Figure 5). Pixel values on the map are between 21.80 and 260.82. These values are divided into 5 equally spaced and the ecological risk levels are classified at 5 levels between "very low" and "very high". On the map, the ecological risk level in the wetland section is higher than the ecological risk level in the terrestrial section, in other words, in the Hisarlı Mountain section to the south of the National Park.

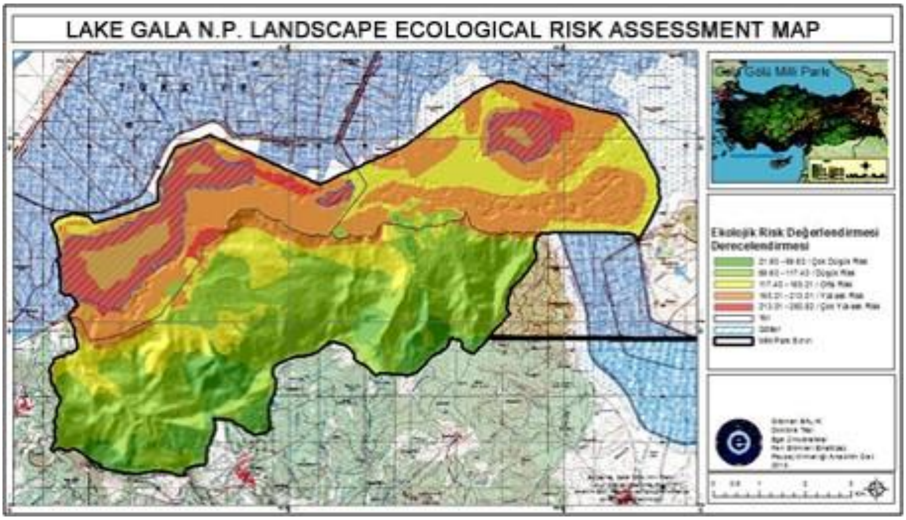


Figure 5. Landscape Ecological Risk Assessment Map of Lake Gala National Park

The parts that are under the pressure most are the outer and inner walls of the lakes. Later, the bird fauna in the reed area continues as breeding, feeding and sheltering areas, other reed and maquis areas, respectively. The total risk score of grazing, hunting and tree cutting, which are the most effective top 3 risks according to the weighted risk level scores is 37.185. It is higher than the sum of the scores of the other 8 risk factors, which is 26.955. Therefore, primarily by avoiding grazing, hunting and tree cutting, total ecological risk impact will reduce by more than half (Figure 5).

6.1.5. *Scenario mapping*

In this step, 2 scenario maps are created for Lake Gala National Park:

Scenario-1: It is based on a management scenario in which the ecological risk factors of "grazing, hunting, tree cutting, fishing and reed burning" are considered completely prevented in practice. The scenario has been created with other risk factors of "agricultural water discharge, drainage channels, water suction from the lake, sets and roads, pressure of agricultural use and mining". The calculation table is shown in Table 11.

Table 11. Scenario-1 Calculation Table

Risk Factor	Severity	Range of consequence	Probability	Risk level	Importance weight in AHP	Weighted risk	Risk ranking number
Agricultural water discharge	4	4	5	80	0.072	5.76	1
Drainage channels	4	3	4	48	0.104	4.992	2
Water suction from the lake	5	3	5	75	0.066	4.95	3
Sets and roads	4	3	4	48	0.1	4.8	4
Pressure of agricultural use	5	3	5	75	0.019	1.425	5
Mining	3	3	4	36	0.012	0.432	6

Landscape ecological risk assessment scenario-1 map of Lake Gala National Park is shown in Figure 6.

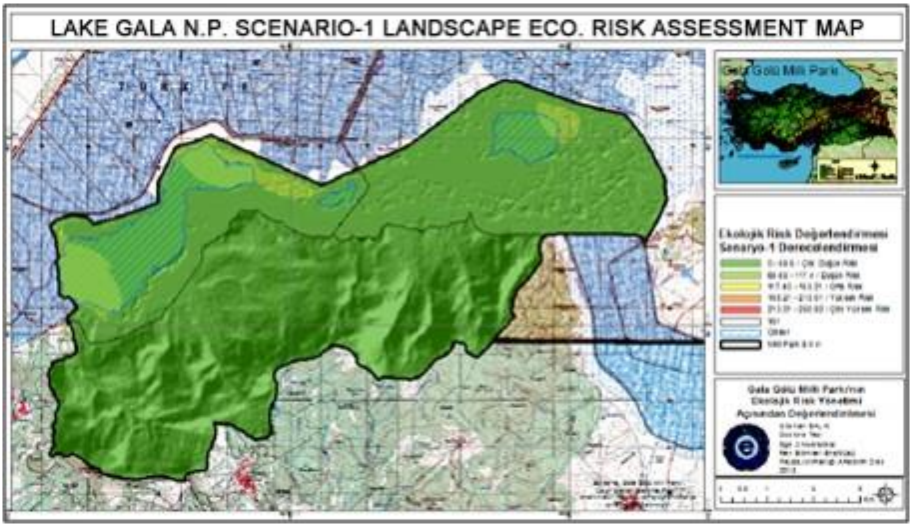


Figure 6. Landscape Ecological Risk Assessment Scenario-1 Map of Lake Gala National Park

Scenario-2: It is based on a management scenario in which the ecological risk factors of "agricultural water discharge, drainage channels, water suction from the lake and pressure of agricultural use" are considered completely prevented in practice. The scenario has been created with other risk factors of “grazing, hunting, tree cutting, sets and roads, fishing, reed burning and mining”. The calculation table and the scenario-2 maps are shown (Table 12, Figure 7):

Table 12. Scenario-2 Calculation Table

Risk Factor	Severity	Range of consequence	Probability	Risk level	Importance weight in AHP	Weighted risk	Risk ranking number
Grazing	5	4	5	100	0.162	16.2	1
Hunting	3	4	5	60	0.206	12.36	2
Tree cutting	5	3	5	75	0.115	8.625	3
Sets and roads	4	3	4	48	0.1	4.8	4
Fishing	3	2	5	30	0.126	3.78	5
Reed burning	3	4	4	48	0.017	0.816	6
Mining	3	3	4	36	0.012	0.432	7

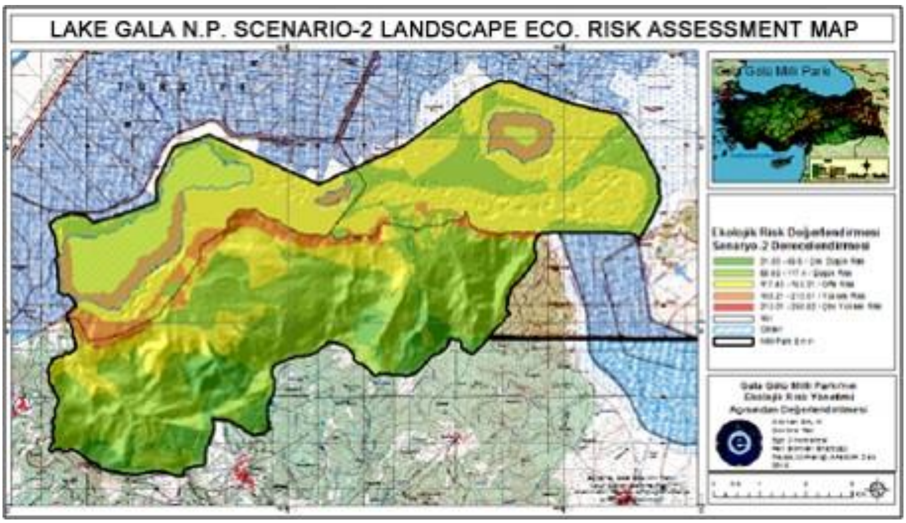


Figure 7. Landscape Ecological Risk Assessment Scenario-2 Map of Lake Gala National Park

6.1.6. Ecological risk scenario management and public participation

When the ecological risk assessment map is compared with the ecological risk assessment scenario-1 map (Figure 5 and 6); for current map, the maximum risk is "very high risk" while for the scenario-1 map, the maximum risk is "very low risk". Thus, if the risk factors are prevented as suggested in Scenario-1, the risk level across the national park will be in the "very low risk" class.

In the Scenario-1 map, it is seen that ecological risks are close to zero in the south parts of the area with Hisarlı Mountain. As highlighted in the map, the Hisarlı Mountain section will be less ecologically threatened by preventing grazing, hunting and tree cutting risk factors.

When the ecological risk assessment map is compared with the ecological risk assessment scenario-2 map (Figure 5 and 7), there is no change in the terrestrial region that is the Hisarlı Mountain part. However, it is observed that in the wetland section, 'high risk' regions have transformed into 'medium risk' areas, and 'medium risk' regions into 'low risk' areas (Figure 6).

Scenario-1 has lower risk levels in general compared to Scenario-2. As a result, uses with high risk factors should be controlled or prevented if possible. Otherwise, the negative effects in the wetland will increase further by cumulation. These decisions are only possible with the participation and acceptance of the local people. Otherwise, it is impossible.

6.1.7. Application and monitoring

This step is for recommendation and completion of the model as it is mentioned in the method section.

7. RESULTS AND DISCUSSION

In the current situation map (Figure 5), the maximum score of regions with "very high" risk is 260.82. The minimum score for non-risk regions is 0. In the ecological risk assessment map, if a risk factor: 1. covers the entire area, 2. gets '5 points' all from the severity, probability and range of consequence, 3. gets 100% from the AHP analysis, 4. if it falls into a very high risk zone (5 points) in the risk factor map then, the maximum score in the ecological risk assessment map would be 625. Although this situation represents total natural destruction risk, it can be calculated as follows in terms of comparing the maximum and minimum ecological risk assessment scores of the same method to be applied in a different area: *625/5 = 125.* In that case: 0-125 points: Very low risk, 125-250 points: Low risk, 250-375 points: Moderate risk, 375-500 points: High risk, 500-625 points: Very high risk. By using the arithmetic mean scale, Lake Gala National Park ecological risk levels are between "very low" and "medium". However, as described in the material and method sections, the national park is under serious pressure and threats. For this reason, it is more appropriate to classify this scale with a different order instead of the arithmetic mean. In fact, while a specific scale is used for Lake Gala National Park where terrestrial and wetland landscapes are together in the area, different types of scales can be used for different landscapes or ecosystems.

While creating the zoning maps in the 3rd step, other models such as hydrological model can be used inside this step. In the 6th Step, statistical tools can also be used for public participation section.

Likewise, pasture management plan, reed cutting plan and agro-ecotourism plan can be prepared in the 6th Step and tested in this model. These scenarios can be evaluated with the participation of the public and can be monitored by applying ecological risk management. In the light of these evaluations, unavoidable risk factors can be reduced. In order to reduce the risk factors, their severity, impact area or probability should be reduced.

8. CONCLUSION

The ecological risk assessment method evaluates the ecological effects of use-oriented risk factors in Lake Gala National Park. The landscape planner or landscape manager evaluates the decisions by simulating them in the scenario. In addition, the same assessment is also useful for predicting the future with the scenario maps. What is important here is to predict the parameters required for the risk factors for the future. Then, these new data will be processed in the method and will present consistent results to the landscape planner or manager.

It is not possible to prevent risk factors by law alone. This issue is manifested in the existing state of the national park. The planned conservation approach in the plans can only be applied with the support of local people. As long as the public does not adopt it, the traditional uses continue to get the maximum benefit without conservation. Educating local people on this issue is a necessity for raising awareness. However, it alone is not enough. Conservation decisions are required to be balanced with the area usage by local people, otherwise environmental problems will increase cumulatively. Landscape planners and managers may benefit from the landscape ecological risk assessment model for prediction and decision, and to convince the law makers and locals.

REFERENCES

Amenu, B. T. and Mamo, G. S. (2018). Review on Wetland Ecosystem Destruction. *International Journal of Scientific Research in Civil Engineering*, JSRCE, 2(2), ISSN : 2456-6667.

Baoyan, M. and Xuelin, Z. (2000). Regional Ecological Risk Assessment of Selenium in Jilin Province, China. Science of The Total Environment, Volume 262, Issues 1–2, Pg: 103-110, ISSN 0048-9697, https://doi.org/10.1016/S0048-9697(00)00588-X

Berni, I., Menouni, A., El Ghazi, I., Godderis, L., Duca, R. C. and El Jaafari, S. (2021). Health and Ecological Risk Assessment Based on Pesticide Monitoring in Saïss Plain (Morocco) Groundwater. Environmental Pollution, Vol. 276, ISSN 0269-7491, https://doi.org/10.1016/j.envpol.2021.116638

BPMS, (2021). Business Performance Management Singapore, AHP Online System Website, Access Date: 27.04.2021, https://bpmsg.com/ahp/ahp-calc.php

Cao, Q., Zhang, X., Lei, D., Guo, L., Sun, X., Kong, F. and Wu, J. (2019). Multi-Scenario Simulation of Landscape Ecological Risk Probability to Facilitate Different Decision-Making Preferences. *Journal of Cleaner Production*, Vol. 227, Pg: 325-335, ISSN 0959-6526, https://doi.org/10.1016/j.jclepro.2019.03.125

Chen, J., Dong, B., Li, H., Zhang, S., Peng, L., Fang, L., Zhang, C. and Li, S. (2020). Study on Landscape Ecological Risk Assessment of Hooded Crane Breeding and Overwintering Habitat. Environmental Research, Vol. 187, 109649, ISSN 0013-9351, https://doi.org/10.1016/j.envres.2020.109649

Chen, S., Chen, B. and Fath, B.D. (2013). Ecological Risk Assessment on the System Scale. A Review of State of the Art Models and Future Perspectives, Ecological Modelling, 250, 25-33.

Darvishi, A., Yousefi, M. and Marull, J. (2020). Modelling Landscape Ecological Assessments of Land Use and Cover Change Scenarios. Application to the Bojnourd Metropolitan Area (NE Iran), Land Use Policy, Vol. 99, 105098, ISSN 0264-8377, https://doi.org/10.1016/j.landusepol.2020.105098

DKMP, (2010). T.C. Orman ve Su İşleri Bakanlığı, Doğa Koruma ve Milli Parklar Genel Müdürlüğü, Gala Gölü Milli Parkı Uzun Devreli Gelişme Planı Analitik Etüd Raporu. Bel-Da Ltd, Ankara, 581 p.

EEA, (2007). European Environment Agency, A Review Models and Methods for Ecological Risk Assessment, Using Svience to Create as Better Place, European Environment Agency Science Report – SC030003/SR, ISBN: 978-1-84432-747-8, 158 p.

Fu, J., Liu, J., Wang, X., Zhang, M., Chen, W. and Chen, B. (2020). Ecological Risk Assessment of Wetland Vegetation under Projected Climate Scenarios in the Sanjiang Plain, China. *Journal of Environmental Management*, Vol. 273, 2020, ISSN 0301-4797, https://doi.org/10.1016/j.jenvman.2020.111108.

Fural, Ş., Kükrer, S. and Cürebal, İ. (2020). Geographical Information Systems Based Ecological Risk Analysis of Metal Accumulation in Sediments of İkizcetepeler Dam Lake (Turkey). Ecological Indicators, Vol. 119, 2020, 106784, ISSN 1470-160X, https://doi.org/10.1016/j.ecolind.2020.106784

Gong, J., Cao, E., Xie, Y., Xu, C., Li, H. and Yan, L. (2021). Integrating Ecosystem Services and Landscape Ecological Risk into Adaptive Management: Insights from a Western Mountain-basin Area, China. *Journal of Environmental Management*, Vol. 281, 111817, ISSN: 0301-4797, https://doi.org/10.1016/j.jenvman.2020.111817

Gong, J., Yang, J. and Tang, W. (2015). Spatially Explicit Landscape-Level Ecological Risks Induced by Land Use and Land Cover Change in a National Ecologically Representative Region in China. *International Journal of Environmental Research and Public Health*, 12, 14192-14215, ISSN 1660-4601, doi:10.3390/ijerph121114192

Hart, B., Webb, J. and Grace, M. (2003). Ecological Risk to Aquatic Systems from Salinity Increase. *Australian Journal of Botany* - AUST J BOT. 51. 10.1071/BT02111.

HGK, (2021). Harita Genel Komutanlığı, Türkiye Fiziki Haritası, Access Date: 27.04.2021. https://www.harita.gov.tr/urun/turkiye-fiziki-haritasi/193

Keddy, P., Lauchlan, F., Ayzik, S., Wolfgang J., Daniel C., Mary K. and Cleber, A. (2009). Wet and Wonderful: The World's Largest Wetlands Are Conservation Priorities. BioScience. 59. 39-51. 10.1525/bio.2009.59.1.8.

Li, Z., Jiang, W., Wang, W., Chen, Z., Ling, Z. and Lv, J. (2020a). Ecological Risk Assessment of the wetlands in Beijing-Tianjin-Hebei urban agglomeration. Ecological Indicators, Volume 117, ISSN: 1470-160X, https://doi.org/10.1016/j.ecolind.2020.106677

Li, W., Wang, Y., Xie, S., Sun, R. and Cheng, X. (2020b). Impacts of Landscape Multifunctionality Change on Landscape Ecological Risk in a Megacity, China: A Case Study of Beijing. Ecological Indicators, Vol. 117, ISSN 1470-160X, https://doi.org/10.1016/j.ecolind.2020.106681

Lin, Y., Hu, X., Zheng, X., Hou, X., Zhang, Z., Zhou, X., Qiu, R. and Lin, J. (2019). Spatial Variations in the Relationships between Road Betwork and Landscape Ecological Risks in the Highest Forest Coverage Region of China. Ecological Indicators, Vol. 96, Pt 1, Pg 392-403, ISSN 1470-160X, https://doi.org/10.1016/j.ecolind.2018.09.016

Luo, F., Liu, Y., Peng J. and Wu, J. (2018). Assessing Urban Landscape Ecological Risk through an Adaptive Cycle Framework. Landscape and Urban Planning, Volume 180, 2018, Pages 125-134, ISSN 0169-2046, https://doi.org/10.1016/j.landurbplan.2018.08.014

Malekmohammadi, B. and Rahimi Blouchi, L. (2014). Ecological Risk Assessment of Wetland Ecosystems Using Multi Criteria Decision Making and Geographic Information System. Ecological Indicators, 41 (2014):133–144.

Meyer, J. L., Kaplan, L. A., Newbold, J. D., Strayer, D. L., Woltemade, C. J., Zedler, J. B., Beilfuss, R., Carpenter, Q., Semlitsch, R., Watzin, M.C. and Zedler, P. H. (2003): Where rivers are born: The Scientific Imperative for Defending Small Streams and Wetlands. Sierra Club and American Rivers.

Radu, L. D. (2009). Qualitative, Semi-quantitative and, Quantitative Methods for Risk Assessment: Case of the Financial Audit. Analele Stiintifice ale Universitatii “Alexandru Ioan Cuza” din Iasi 56, 643–657.

Rico, A., Van den Brink, P., Gylstra, R., Focks, A. and Brock, T. (2015). Developing Ecological Scenarios for the Prospective Aquatic Risk Assessment of Pesticides. Integrated Environmental Assessment and Management. 12. 10.1002/ieam.1718.

USEPA, (1992). Guidelines for Ecological Risk Assessment, Washington DC, Risk Assessment Forum, U.S. Environmental Protection Agency, EPA/630/R-92/001, 41p.

Wang, H., Liu, X., Zhao, C., Chang, Y., Liu, Y. and Zang, F. (2021). Spatial-temporal Pattern Analysis of Landscape Ecological Risk Assessment Based on Land use/land Cover Change in Baishuijiang National Nature Reserve in Gansu Province, China. Ecological Indicators, Vol. 124, 107454, ISSN 1470-160X, https://doi.org/10.1016/j.ecolind.2021.107454

Wang, B., Ding, M., Li, S., Liu, L., Ai, J. (2020). Assessment of Landscape Ecological Risk for a Cross-border Basin: A Case Study of the Koshi River Basin, Central Himalayas. Ecological Indicators, Vol. 117, ISSN: 1470-160X, https://doi.org/10.1016/j.ecolind.2020.106621

Wu, J., Zhu, Q., Qiao, N., Wang, Z., Sha, W., Luo, K., Wang, H., Feng, Z. (2021). Ecological Risk Assessment of Coal Mine Area Based on “Source-sink” Landscape Theory – A Case Study of Pingshuo Mining Area. *Journal of Cleaner Production*, Vol. 295, ISSN: 0959-6526, https://doi.org/10.1016/j.jclepro.2021.126371

WWF, 2011, Türkiye’nin Sulak Alanlarının Korunması, Sorunlar ve Çözüm Önerileri, World Wildlife Foundation Turkey (Doğal Hayatı Koruma Vakfı) Report, Access Link: Access Date: 21.04.2021. https://wwftr.awsassets. panda.org/downloads/2subat_bilginotu.pdf?1401/sulakalanarimizinkorunmas i

Xu, X., Lin, H., Fu, Z. (2004). Probe into the Method of Regional Ecological Risk Assessment – a Case Study of Wetland in the Yellow River Delta in China, *Journal of Environmental Management* 70, 253-262.

CHAPTER 10

COMPARISON OF BIOCLIMATIC COMFORT CONDITIONS OF URBAN, SUBURBAN AND RURAL SETTLEMENTS

Assoc. Prof. Dr. İsmail ÇINAR[1]

Lecturer Nihat KARAKUŞ [2*]

[1] Muğla Sıtkı Koçman University, Vocational School of Fethiye Ali Sıtkı Mefharet Koçman, Department of Park and Horticulture, Muğla, Turkey. E-mail: icinar@mu.edu.tr ORCID ID: 0000-0002-0234-0178

[2*] Akdeniz University, Vocational School of Serik Gülsün-Süleyman Süral, Department of Park and Horticulture, Antalya, Turkey. E-mail: nkarakus@akdeniz.edu.tr ORCID ID: 0000-0002-6924-1879

INTRODUCTION

Different methods are used in the separation of settlement areas in the world. The most widely used criterion in our country is amount of population (Yılmaz, 2019). While settlements with a population of more than 20000 are accepted as urban settlements, other settlements are considered as rural settlements (Anonymous, 2010; Aydınlı and Çiftçi, 2015). Urban settlements; They are densely populated and organized settlements where most of the inhabitants make a living from non-agricultural activities. Rural settlements; It is defined as the regions where the majority of the inhabitants make a living from agriculture and livestock activities, the population is not together but randomly distributed to the land, and organizations such as municipal services have not yet developed sufficiently (Yılmaz, 2019). Since urban settlements are the places where human activities such as transportation, industrial and agricultural production, consumption and social activities are most intense, their negative impact on natural resources nearby are also greater (Üstündağ et al., 2011; Mansuroğlu et al., 2006; Olgun, 2019; Olgun and Yılmaz, 2019a). Rural settlements are the places where meet the need of the local people, suitable for the natural environment-land form, compatible with the climate and care about cultural values (Usman, 2011). Suburban is a settlement located far from the city center or close to its borders. The common features of all definitions in the literature regarding the distinction between rural and urban settlements are population density and socio-economic developments.

Nowadays, it is a known and accepted fact that there are climate differences between urban areas and rural areas. Urbanization and industrialization affect the heat and water cycle in the boundary layer of the atmosphere and differentiate the urban climate from the rural settlement (Yüksel and Yılmaz, 2008; Demircan et al., 2017; Benliay et al. 2020). Many planned and unplanned developments that occur during the urbanization process affect the urban climate (Balık and Yüksel, 2014; Dursun et al., 2016; Olgun, 2018; Olgun and Yılmaz, 2019b). Changes in climate parameters in settlements are caused changes in bioclimatic comfort conditions. Factors affecting bioclimatic comfort are environmental conditions and personal parameters. These are temperature, air humidity, air movement, radiation and personal factors. Personal factors are activity-related metabolism's regulation of temperature, activity level, and clothing isolation (Çınar, 1999; Matzarakis, 2003; Toy, 2010; Topay, 2012; Topay, 2013; Mirza, 2014; Çınar et al., 2019). Bioclimatic comfort Koichi (1996) is defined as the climatic condition in which people live in a healthy and dynamic environment, Berköz (1969) is defined as the conditions in which people can adapt to their environment by spending a minimum amount of energy. Bioclimatic indexes are models that are put forward to determine how atmospheric conditions affect the human organism through experimental studies (Çınar, 2004). One of the most important indexes developed to reveal the bioclimatic comfort structure of a region is the Physiological Equivalent Temperature (PET), which is prepared based on the "energy balance". PET is a very suitable method for evaluating the thermal components of regions with different climatic conditions. This method is an index that takes into account the physiological characteristics of individuals as well as climate parameters and reflects these characteristics to the results. Since PET gives the results in degrees Celsius, many professional disciplines also are used this method in their studies. Comfort status can be shown in tables or graphics as well as in the form of maps (Matzarakis et al., 1999; Şahingöz, 2017; Çınar et al., 2019).

In this study, it was aimed to determine the bioclimatic comfort conditions in urban, suburban and rural settlements and compare with each other by detecting differences between them.

1. MATERIAL AND METHOD

In this study, it was selected Fethiye as urban settlement, Seydikemer as suburban settlement and Elmalı as the rural settlement (Figure 1). The research area is located in the south of Anatolia and in the Mediterranean region. The settlements in the research area are located from west to east as Fethiye, Seydikemer and Elmalı.

Fethiye, is an example for urban settlement definition. Fethiye urban settlement is located in the west of the district and on the Mediterranean coast. Fethiye is a typical coastal city located in the Mediterranean climate zone. Urban settlement is spread over a wide area in the coastal line. Its population is 167114.

Seydikemer, is an example for suburban definition. In the north it is covered with pine forest and in the south is open to coastal features. In the night time wind is coming from north direction and in the day time it is under the effect of sea breezes. Settlements are located in a large scale. Its population is 61306.

Elmalı, is an example for rural settlement. Its climatic characteristic is terrestrial characteristic. It is far from coastal features. İt is covered with black pine trees. Its population is 39365.

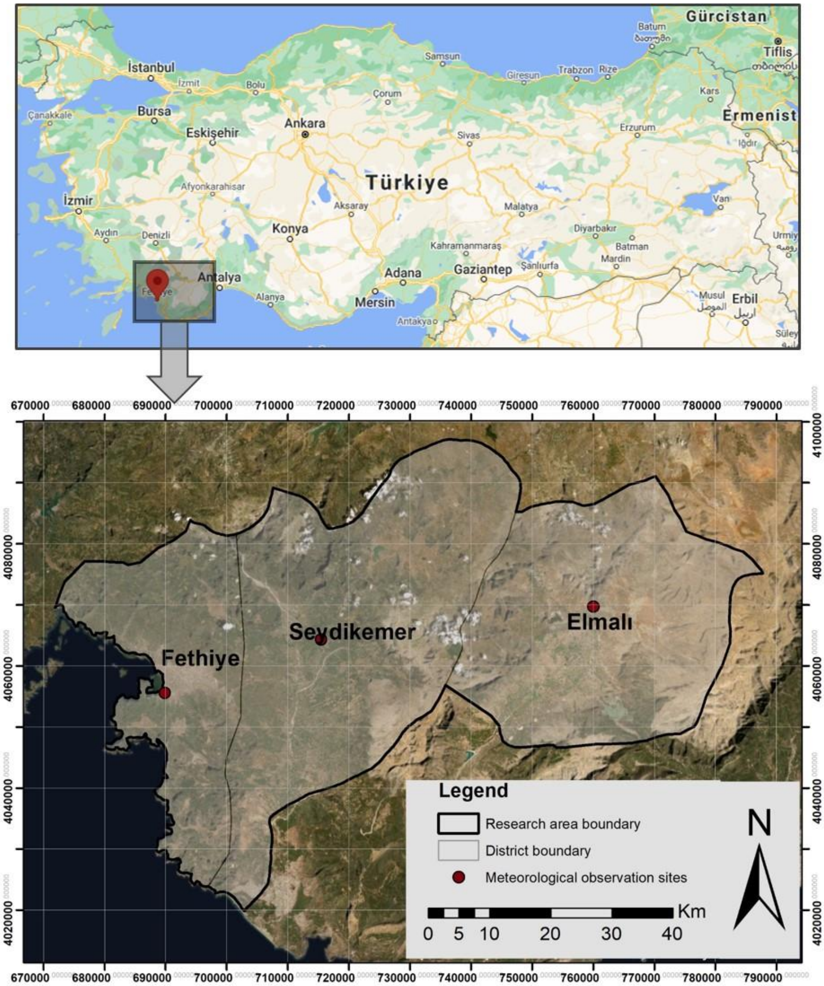


Figure 1. Research area and meteorological observation sites

Fethiye, Seydikemer and Elmalı meteorology observation sites data are constituted the main material of the study. In addition, it was benefited from the studies on the research area and literature studies on bioclimatic comfort. In the study, Fethiye, Seydikemer and Elmalı meteorology observation sites data were used to determine bioclimatic comfort. Fethiye meteorology observation site is located at 36.6266 N, 29.1238 E coordinates. Seydikemer meteorology observation site is located at 36.8764 N, 29.6642 E coordinates. Elmalı meteorology observation site is located at 36.5842 N, 29.9892 E coordinates.

As stated in Olgyay (1973), bioclimatic comfort in the Mediterranean Climate Zone is deteriorated the most during the day between May and October. Therefore, climate data (Temperature, Wind, Cloudiness, Relative humidity) for the period May-October were obtained from Fethiye, Seydikemer and Elmalı meteorology observation sites (Table 1).

Table 1. Meteorology Observation Sites Monthly Average Data

Meteorological observation sites		May	Jun	Jul	Aug	Sep	Oct	Annual average
Fethiye	Average Temperature (°C)	20,5	24,8	27,5	27,4	24,0	19,2	18,4
	Average Relative Humidity (%)	74,0	71,0	70,0	70,0	79,0	75,0	75,0
	Average Cloudiness (1/8)	3,2	1,6	0,7	0,8	1,2	3,0	3,2
	Average Wind Speed (m/s)	1,4	1,6	1,7	1,5	1,4	1,3	1,4
Seydikemer	Average Temperature (°C)	20,3	26	30	28	24	18	24,3
	Average Relative Humidity (%)	65	53	42	59	57	68	57,3
	Average Cloudiness (1/8)	2	1	0,4	0,6	1	2	1,2
	Average Wind Speed (m/s)	1.6	1,7	1,8	1,6	1.6	1.6	1.7
Elmalı	Average Temperature (°C)	17,4	22,4	26,1	25,6	21,6	15,8	21,5
	Average Relative Humidity (%)	60	48	41	42	48	61	40,0
	Average Cloudiness (1/8)	4	1,8	0,8	0,8	3,6	3,2	2,6
	Average Wind Speed (m/s)	3	3,5	3,8	3,6	3,2	2,6	33,0

Physiological Equivalent Temperature (PET) was obtained by analyzing monthly average temperature, humidity, wind speed and cloudiness data with RayMan software. PET data of each station obtained was transferred to GIS. Monthly bioclimatic comfort maps were created between May and October in spatial scale by performing IDW analysis in the GIS. The created maps were classified and bioclimatic comfort status was evaluated. In addition, it was used bioclimatic comfort criteria which was created by Matzarakis et al. (1999) in the evaluation of bioclimatic comfort (Table 2).

Table 2. Thermal detection and PET values (Matzarakis et al., 1999).

PET (°C)	Thermal Detection	Physiological Stress Categories
<4	Very cold	Extreme cold stress
4 – 8	Cold	Very cold stress
8 – 13	Cool	Moderate cold stress
13 – 18	Slightly cool	Mild cold stress
18 – 23	**Comfartable**	No thermal stress
23 – 29	Slightly worm	Mild heat stress
29 – 35	Warm	Moderate heat stress
35 – 41	Hot	Very hot stress
>41	Very Hot	Extreme heat stress

2. RESULTS AND DISCUSSION

In this study, temperature, relative humidity, wind speed and cloudiness data obtained from Fethiye, Seydikemer and Elmalı meteorology observation sites were classified as monthly averages in order to determine bioclimatic comfort conditions of three different settlements is urban, suburban and rural characteristics. PET values were obtained by analyzing classified data separately for each month in RayMan software (Figure 2). The temperature difference between urban settlement and suburban settlement, temperature difference between urban settlement and rural settlement and temperature difference between suburban settlement and rural settlement was obtained using the PET data (Figure 3).

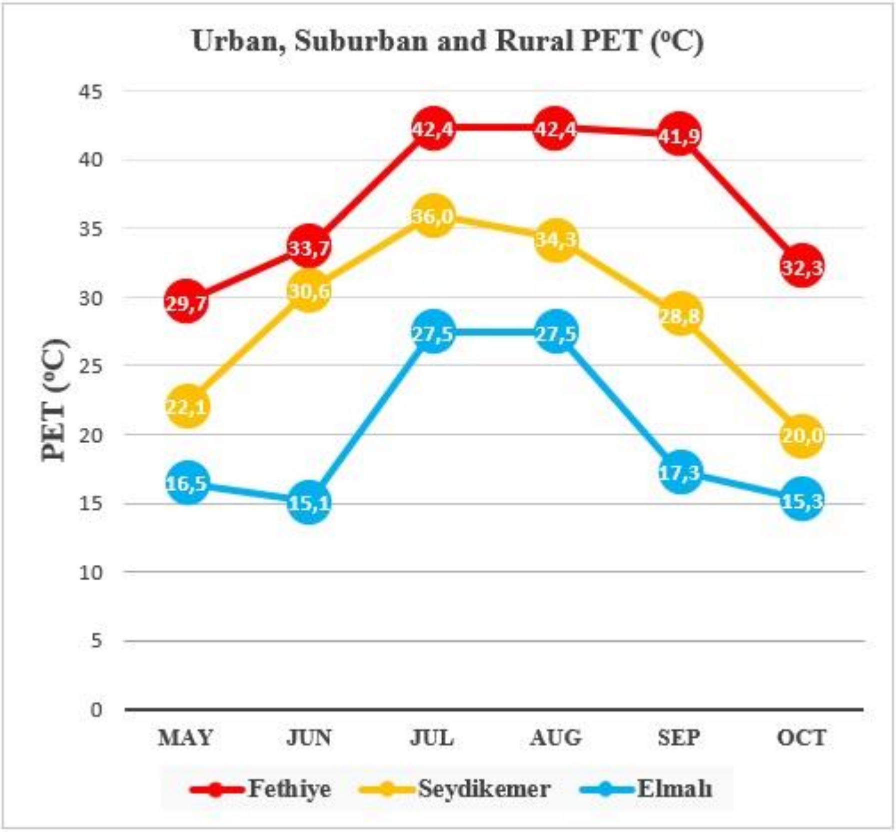


Figure 2. PET Chart of urban, suburban and rural areas from May to Oct

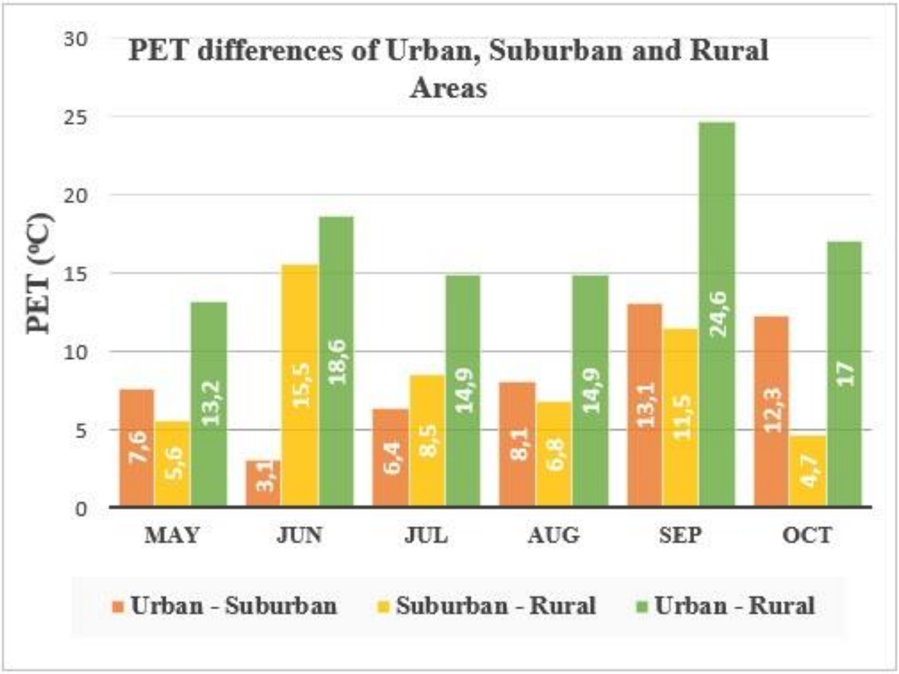


Figure 3. PET differences for urban, suburban and rural areas from May to Oct

In May, PET value was obtained as 29.7 °C in urban settlement, 22.1 °C in suburban settlement and 16.5 °C in rural settlement. It was observed that urban settlement is 7.6 °C warmer than suburban settlement and 13.2 °C warmer than rural settlement. It was observed that suburban settlement is 5.6 °C warmer than rural settlement. While bioclimatic comfort conditions are occurred in suburban settlement, they are partially deteriorated in urban and rural settlement. Bioclimatic comfort conditions are deteriorated due to mild heat stress in urban settlements while it is deteriorated due to mild cold stress in rural settlements.

In June, PET value was obtained as 33.7 °C in urban settlement, 30.6 °C in suburban settlement and 15.1 °C in rural settlement. It was observed that urban settlement is 15.1°C warmer than suburban settlement and 18.6 °C warmer than rural settlement. It was observed that suburban settlement is 3.1 °C warmer than rural settlement. Bioclimatic comfort conditions are partially deteriorated in all settlements. Bioclimatic comfort conditions are deteriorated due to mild heat stress in urban and suburban settlements while it is deteriorated due to mild cold stress in rural settlements.

In July, PET value was obtained as 42.4 °C in urban settlement, 36.0 °C in suburban settlement and 27.5 °C in rural settlement. It was observed that urban settlement is 6.4°C warmer than suburban settlement and 14.9 °C warmer than rural settlement. It was observed that suburban settlement is 8.5 °C warmer than rural settlement. Bioclimatic comfort conditions are deteriorated due to heat stress in all settlements. Bioclimatic comfort conditions are deteriorated due to extreme heat stress in the urban settlement, very hot stress in the suburban area, and mild heat stress in the rural settlement.

In August, PET value was obtained as 42.4 °C in urban settlement, 34.3 °C in suburban settlement and 27.5 °C in rural settlement. It was observed that urban settlement is 8.1 °C warmer than suburban settlement and 14.9 °C warmer than rural settlement. It was observed that suburban settlement is 8.1 °C warmer than rural settlement. Bioclimatic comfort conditions are deteriorated due to heat stress in all settlements. Bioclimatic comfort conditions are deteriorated due to extreme heat stress in the urban settlement, medium hot stress in the suburban area, and mild heat stress in the rural settlement.

In September, PET value was obtained as 41.9 °C in urban settlement, 28.8 °C in suburban settlement and 17.3 °C in rural settlement. It was observed that urban settlement is 13.1 °C warmer than suburban settlement and 24.6 °C warmer than rural settlement. It was observed that suburban settlement is 11.5 °C warmer than rural settlement. Bioclimatic comfort conditions are deteriorated in all settlements. Bioclimatic comfort conditions are deteriorated due to extreme heat stress in urban settlement and mild heat stress in suburban while it is deteriorated due to mild cold stress in rural settlements.

In October, PET value was obtained as 32.3 °C in urban settlement, 20.0 °C in suburban settlement and 15.3 °C in rural settlement. It was observed that urban settlement is 12.3 °C warmer than suburban settlement and 17.0 °C warmer than rural settlement. It was observed that suburban settlement is 4.7 °C warmer than rural settlement. While bioclimatic comfort conditions are occurred in suburban settlement, they are partially deteriorated in urban and rural settlement. Bioclimatic comfort conditions are deteriorated due to mild heat stress in urban settlements while it is deteriorated due to mild cold stress in rural settlements.

PET data were transferred to the GIS software for each month from May to October. Spatial distribution of PET data was obtained by performing IDW analysis in GIS software and monthly PET maps were created (Figure 4).

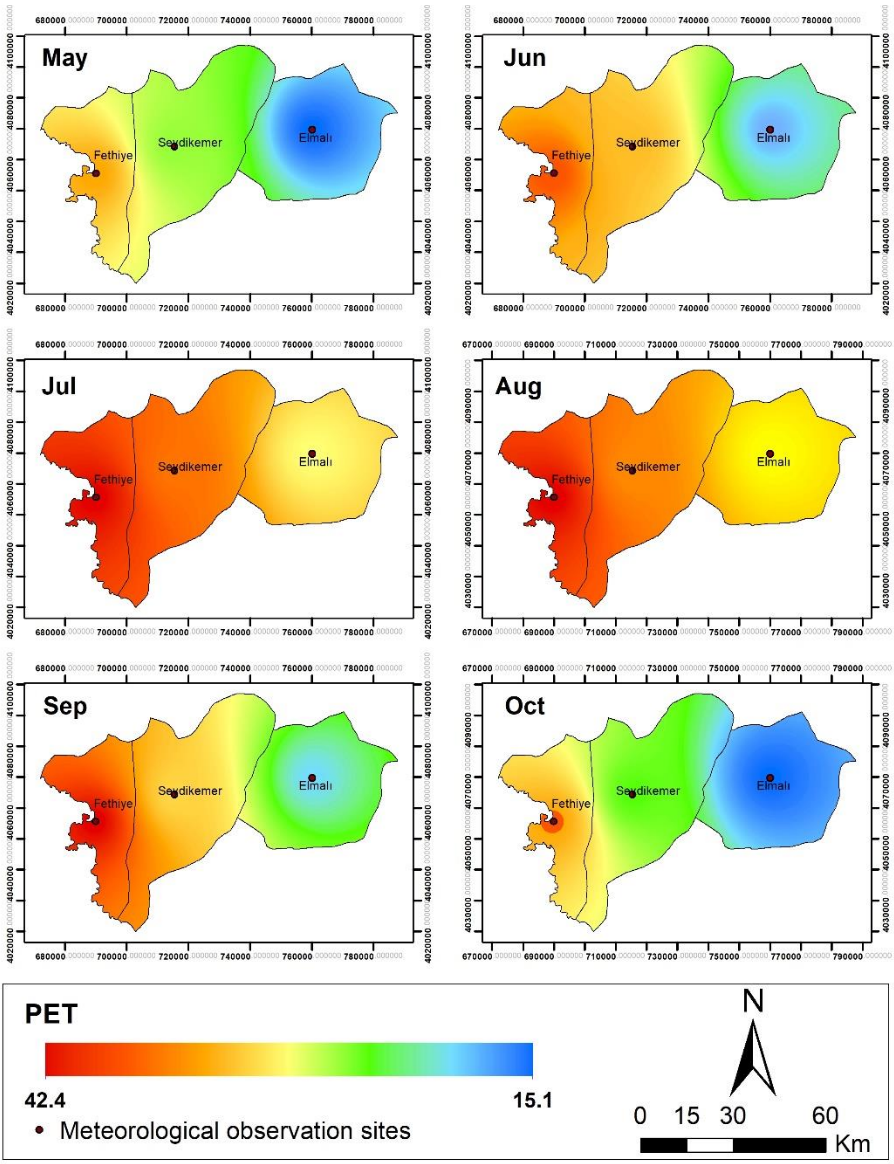


Figure 4. PET for urban, suburban and rural settlements from May to Oct

According to PET map, bioclimatic comfort conditions are partially deteriorated in urban settlements due to mild heat stress in May and June. Bioclimatic comfort conditions are completely deteriorated in urban settlements due to extreme heat stress in July, August and September. Bioclimatic comfort conditions are partially deteriorated in urban settlements due to mild heat stress in October.

According to the PET map, bioclimatic comfort conditions are occurred in suburban settlement in May. Bioclimatic comfort conditions are partially deteriorated in suburban settlement due to mild heat stress in June. Bioclimatic comfort conditions are deteriorated in suburban settlement due to very hot stress in July. Bioclimatic comfort conditions are deteriorated in suburban settlement due to moderate heat stress in August. Bioclimatic comfort conditions are partially deteriorated in suburban settlement due to mild heat stress in September. Bioclimatic comfort conditions are reoccurred in suburban settlement in October.

According to the PET map, bioclimatic comfort conditions are partially deteriorated in rural settlement due to mild cold stress in May and June. Bioclimatic comfort conditions are partially deteriorated in rural settlement due to mild heat stress in July and August. Bioclimatic comfort conditions are partially deteriorated in rural settlement due to mild cold stress in September and October. The results of this study has been similar to the results of the studies conducted in different climatic zones (Unger, 1999; Robaa, 2003; Han et al., 2009; Bulgan and Yılmaz, 2017; Xiong et al., 2019).

3. CONCLUSION

In this study, it was determined the bioclimatic comfort conditions in urban, suburban and rural settlements and the differences between them were determined and compared. It was observed that the highest temperature difference (13.1 °C) in September, the lowest temperature difference (3.0 °C) in June between the urban and suburban settlements. It was observed that the highest temperature difference (15.5 °C) in June, the lowest temperature difference (4.7 °C) in October between the suburban and rural settlements. It was observed that the highest temperature difference (24.6 °C) in September, the lowest temperature difference (13.2 °C) in June between the urban and rural settlements.

As a result, it was observed that bioclimatic comfort conditions do not occur in the urban settlement due to hot stress. It was observed that bioclimatic comfort conditions occurred in the suburban settlement in May and October, however bioclimatic comfort conditions do not occur in other months due to hot stress. It was observed that bioclimatic comfort conditions do not occur in rural settlement due to hot stress in July and August, and cold stress in other months. In future studies, it is predicted that determining the bioclimatic comfort hourly in order to determine whether the deteriorating comfort conditions in urban, suburban and rural settlements have deteriorated during the day or at a certain time interval will take these studies to further levels.

Acknowledgments: The authors thank MGM for providing data.

REFERENCES

Anonymous, 2010. Kırsal Kalkınma Planı (2010-2013), T.C. Tarım ve Köyişleri Bakanlığı Yayınları, Ankara.

Aydınlı, H. I. and Çiftçi, S. (2015). Türkiye'de Kır-Kent Kavramlarının Değişen Niteliği ve Mevzuatın Sürece Etkisi. *Electronic Journal of Social Sciences*, *14*(54).

Balık, H. and Yüksel, Ü. D. (2014). Planlama sürecine iklim verilerinin entegrasyonu. *Türk Bilimsel Derlemeler Dergisi*, *7*(2), 01-06.

Benliay A., Yilmaz T., Olgun R., Ak M.K. (2020). NDVI indicated changes in vegetation and their relations to climatic comfort factors in Demre-Akcay Sub basin, Turkey. *Journal of Environmental Biology*, 41(2): 344-350.

Berköz, E. (1969). Biyoklimatik Konfor Yönünden Tavan Yüksekliğinin Balirlenmesinde Kullanılabilecek Bit Method. İstanbul Teknik Üniversitesi, Mimarlık Fakültesi, Doktora Tezi, 99s, İstanbul.

Bulgan, E. and Yılmaz, S. (2017). Farklı Kent Dokularının Yaz Aylarında Biyoklimatik Konfora Etkisi: Erzurum Örneği. *Iğdır Üniversitesi Fen Bilimleri Enstitüsü Dergisi*, *7*(4), 235-242.

Çinar İ., Karakuş N. and Ardahanlioğlu Z.R. (2019). "Biyoklimatik Konfora Sahip Alanların Belirmesi: Dalaman Örneği", V. Science Technology and Innovation Congress, Antalya, TÜRKIYE, pp.444-448.

Çınar, İ. (1999). *Fiziksel Planlamada Biyoklimatik Veriler Kullanarak Biyokonforun Oluştrulması Üzerine Fethiye Merkezi Yerleşimi Üzerinde Araştırmalar*. Ege Üniversitesi, Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, 101s, İzmir.

Çınar, İ. (2004). *Biyoklimatik Konfor Ölçütlerinin Peyzaj Planlama Sürecinde Etkinliği Üzerinde Muğla-Karabağlar Yaylası Örneğinde Araştırmalar.* Ege Üniversitesi, Fen Bilimleri Enstitüsü, Doktara Tezi, 248s, İzmir.

Demircan, M., Arabacı, H., Akçakaya, A., Şensoy, S., Bölük, E., and Coşkun, M. (2017). İklim ve Şehirleşme Minimum Sıcaklık Trendleri, IV. *Türkiye İklim Değişikliği Kongresi, TİKDEK*, 5-7.

Dursun, D., Yavaş, M. and Güller, C. (2016). Kış kenti Erzurum'da iklim, planlama ve yerel yönetim politikalarının etkileşim düzeyi. *Planlama Dergisi, 26*(2), 147-159.

Han, J., Yang, W., Zhou, J., Zhang, G., Zhang, Q. and Moschandreas, D.J. (2009). A comparative analysis of urban and rural residential thermal comfort under natural ventilation environment. *Energy and Buildings*, 41(2), 139-145.

Koichi N. (1996). Evaluation of the thermal environment in an outdoor pedestrian space. *Atmospheric Environment*, 30:497-505.

Mansuroglu, S., Ortacesme, V. and Karaguzel, O. (2006). Biotope mapping in an urban environment and its implications for urban management in Turkey. *Journal of environmental management*, *81*(3), 175-187.

Matzarakis, A. (2003). *Assessing Climate for Tourism Purposes: Existing Methods and Tools for The Thermal Complex.* Meteorological Institute, University of Freiburg, 101-105.

Matzarakis, A., Mayer, H. and Iziomon, M.G. (1999). Application of Universal Thermal Index: Physiological Equivalent Temperature, *Int J. Biometeorol*, 43: 76-84.

Mirza, E. (2014). *Rekreasyonel Planlama İçin Biyoiklimsel Konfor Özelliklerinin Belirlenmesi: Isparta Kent Merkezi Örneği.* Süleyman Demirel Üniversitesi, Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, 123 s, Isparta.

Olgun, R. (2018). *Niğde Kenti Açık ve Yeşil Alanlarına Yönelik Stratejik Hedeflerin Belirlenmesi ve Planlama Stratejilerinin Geliştirilmesi*. Akdeniz Üniversitesi, Fen Bilimleri Enstitüsü, Doktora Tezi, 302 s, Antalya.

Olgun, R. (2019). Orta ölçekli kentler için kentsel yeşil alan sistem önerisi: Niğde Kenti Örneği. *Artium*, *7*(1), 57-69.

Olgun, R. and Yılmaz, T. (2019a). A'wot method in determination of sustainable strategic objectives towards open green areas in the medium sized cities: The case of Nigde, Turkey. *Fresenius Environmental Bulletin*, *28*(7), 5188-5194.

Olgun R. and Yılmaz T. (2019b). Evaluation of zoning plans with landscape ecology approach: the case of Nigde city. *Süleyman Demirel University Journal of Natural and Applied Sciences*, 23(3): 770-779.

Robaa, S. M. (2003). Urban-suburban/rural differences over Greater Cairo, Egypt. *Atmósfera*, *16*(3), 157-171.

Şahingöz, M. (2017). *Seyhan Irmağı Havzası Biyoiklimsel Konfor Yapısı'nın Belirlenmesi.* Süleyman Demirel Üniversitesi, Fen Bilimleri Enstitüsü, Yüksek Lisans Tezi, 96s, Isparta.

Topay, M. (2012). Importance of Thermal Comfort in the Sustainable Landscape Planning, *Journal of Environmental Protection and Ecology,* 13(3):1480-1487

Topay, M. (2013). Mapping of Thermal Comfort for Outdoor Recreation Planning Using GIS: The Case of Isparta Province (Turkey). *Turkish Journal of Agriculture and Forestry*, 37,110-120.

Toy, S. (2010). *Biyoklimatik Konfor Değerleri Bakımından Doğu Anadolu Bölgesi Rekreasyonel Alanlarının İncelenmesi.* Atatürk Üniversitesi, Fen Bilimleri Enstitüsü, Doktora Tezi, 206s, Erzurum.

Unger, J. (1999). Comparisons of urban and rural bioclimatological conditions in the case of a Central-European city. *International Journal of Biometeorology*, *43*(3), 139-144.

Usman, E. E. (2011). Kırsal Yerleşimlerin Biçimlenmesinde Su Etkisi ve Eskişehir Örneği. *Çevre Tasarım Kongresi Bildiri Kitabı*, 57-66.

Üstündağ, Ö., Devecioğlu, S. and Akarsu, E. (2011, May). Elazığ şehir merkezinde spor ve rekreasyon alanları dağılımlarının coğrafi bilgi sistemleri metodu ile analizi. In *6th International Advanced Technologies Symposium (IATS'11),* pp. 15-19.

Xiong, Y., Liu, J. and Kim, J. (2019). Understanding differences in thermal comfort between urban and rural residents in hot summer and cold winter climate. *Building and environment*, *165*, 106393.

Yılmaz, C. (2019). Türkiye kırsal yerleşme coğrafyası literatürü. *Türkiye Araştırmaları Literatür Dergisi*, *17*(34), 519-560.

Yüksel, Ü. D. and Yılmaz, O. (2008). Ankara kentinde kentsel ısı adası etkisinin yaz aylarında uzaktan algılama ve meteorolojik gözlemlere dayalı olarak saptanması ve değerlendirilmesi. *Gazi Üniversitesi Mühendislik Mimarlık Fakültesi Dergisi*, *23*(4).

CHAPTER 11

EVALUATION OF THERMAL COMFORT IN CAMPUS DESIGNS WITHIN THE SCOPE OF OPEN AND GREEN AREAS

Assoc. Prof. Dr. Arzu ALTUNTAŞ [1*]

Assoc. Prof. Dr. Ahmet BENLİAY [2]

[1*] Siirt University, Faculty of Agriculture, Department of Landscape Architecture, Siirt, Turkey. E-mail: arzualtuntas@yahoo.com.tr ORCID ID: 0000-0003-1258-3875
[2] Akdeniz University, Faculty of Architecture, Department of Landscape Architecture, Antalya, Turkey. E-mail: benliay@akdeniz.edu.tr ORCID ID: 0000-0002-0902-2658

INTRODUCTION

Human is a being that lives in nature and as a part of nature. For this reason, it is affected by all kinds of conditions that occur in nature and it affects these conditions to a certain extent. Climate is at the top of the conditions in which people are particularly physically affected.

The climate, which is defined as the average weather conditions in a wide region for many years (Yalçın et al. 2005; Bulğan 2014), occurs depending on various conditions such as the region's altitude above sea level, latitude and longitude. In other words, climate is long-term statistics based on average 30-year periods of weather events such as temperature, humidity, wind, and precipitation of a region (Demircan et al. 2013). Climate has an important effect on the diversification and distribution of both natural events and human factors on the earth. According to Bulğan (2014), while the climate affects natural features such as the state of landforms, agricultural products, animal species and stream flows, it also directs human activities such as settlement selection, industry branches, housing diversity, material selection, transportation and tourism activities. For this reason, the climate has a close relationship with the human being and therefore with the settlement and city they live in.

Researches show that there is an absolute interaction between urban planning and climate and that the effect of climate should be taken into account in the urban planning process (Olgyay 1973; Yang et al. 2011). As a result of his studies, Oke (2006) mentions four factors and the importance of these factors on urban climate. These are urban structure (dimensions of buildings and spaces between them, street widths and spacing) (Oke 1988; Johansson 2006; Priyadarsini et al. 2008), urban cover (building parts, floors, vegetation, bare soil and water) (Whitford et al. 2001; Pauleit et al. 2005), urban texture- structural and natural materials (Doulos et al. 2004; Priyadarsini et al. 2008) and urban metabolism (pollutants from human activities) (Zhao et al. 2011; Bulğan 2014). The effects of these factors on the urban climate determine the characteristics of the city and its inhabitants such as human health, comfort, lifestyle, habits and urban development. At this point, the interaction between the city and the climate is balanced and healthy, providing optimal conditions for people and thus bioclimatic comfort.

Bioclimatic comfort is the adaptation of a person to his environment by spending less energy as a result of the formation of climatic conditions in which people feel healthy and dynamic (Cohen et al. 2013). In recent years, ecological designs have been made in order to create / increase bioclimatic comfort in cities and especially efforts are made to increase the green texture of the city.

University campuses are large areas in the city and its immediate environment, included in the open and green space systems of the cities. The areas outside the faculty and administrative buildings in the campuses both contribute to the open and green space system of the city where they are located and respond to the active and passive recreation needs of the students and academic and administrative staff using the campus. From this point of view, the comfort levels of the campus users depend on the successful arrangement of the open and green space system in the area, the selection of vegetation species and sustainable landscape planning and design.

1. TEMPERATURE-SHADE-COMFORT

The climatic data that most affect human comfort are temperature, humidity, precipitation and wind. According to Toy and Yılmaz (2009), the effect of climatic elements belonging to the atmosphere on human comfort is not only the effect of elements directly coming to the human body. In addition, the intensity of these effects can vary depending on the environment people live in, the work they do, and the clothes they wear.

Today, the changes in lifestyles and habits have caused the climate change to reach serious dimensions and especially the temperatures to rise noticeably. The increase in climatic data is one of the main conditions that negatively affect human and living life. Temperature values are the factors that most affect bioclimatic comfort and therefore the comfort levels of living things, especially human beings. If the temperature is below or above the comfort values, it causes various diseases in terms of human health. The shadow effect can be used to partially or completely eliminate these ailments. The shadow effect can be achieved by structural elements (pergola, porch, etc.) or by vegetation.

Vegetation is the most effective landscape element in changing surface and air temperature and can be used very effectively as a means of controlling the sun rays (Attia and Duchhart, 2011). Datta (2001), in his study in 4 cities of Italy, accepts that the shadow element provides the values of < 40% shade in winter and > 70% shade area in summer as a suitable solution. Hassaan and Mahmoud (2011) investigated the user preferences by dividing the area into zones in a city park in Cairo, Egypt, and found that there was a lack of vegetative material in areas with the least use of land and these areas were not used due to the temperature difference. Armson et al. (2012) found that the use of trees in urban landscapes reduces the ambient temperature by 5-7º C and as a result, tree shades are effective in terms of local cooling. In addition, from an economic perspective, Gómez-Mu˜noz et al. (2009), in their study in hot and dry climates, concluded that large trees provide up to 70% shade in spring and are beneficial in terms of energy savings. On the other hand, Durdu (2015), in her study in the sample area, found that although the number of plants in the area is sufficient, plant age, plant type, design errors are important factors in increasing or decreasing the comfort level. She stated that the field users' preferences to use the area (such as season, month, day or certain hours of the day) are shaped accordingly.

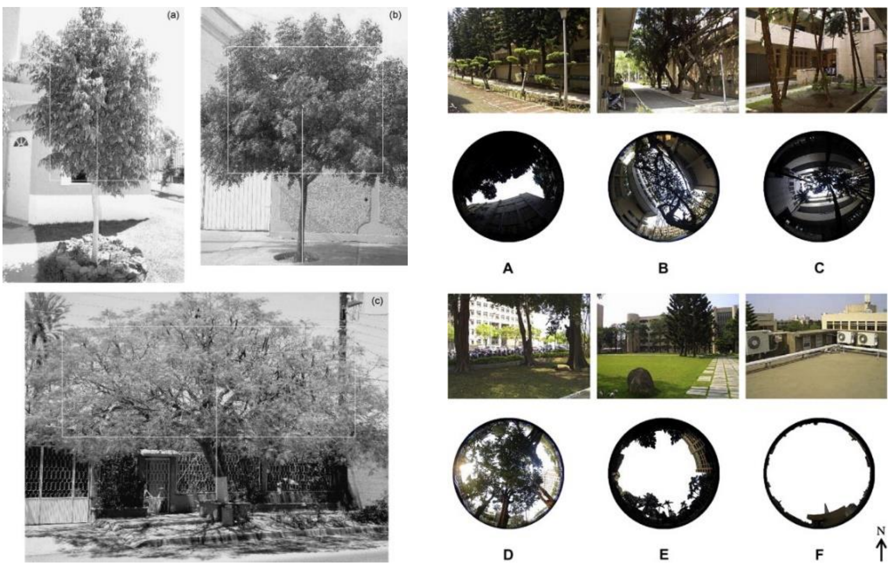
While the shading and moisturizing effects of plants in adequately and properly planted areas prevent heat stress in summer, deciduous plants in winter can help the areas escape from cold stress by not obstructing sunlight (Toy and Yılmaz, 2009). For this reason, this issue should definitely be taken into consideration both in the inner city and its immediate surroundings and in campus designs.

2. OPEN AND GREEN SPACES-COMFORT

Many studies have been conducted on open and green areas in Turkey and in the world up to now. Gül and Küçük (2001) referred to the characteristics and classification of open and green spaces in their study titled “The Research of Isparta and the Open-Green Areas in Urban” and drew attention to the lack of open and green spaces and the increasing need for recreational areas in the city of Isparta. As a result of the study, they found that the existing active open and green areas (city and neighborhood parks, children’s parks and playgrounds) in Isparta were insufficient in terms of quality and quantity, and there was 3 m^2 space per person. Ortaçeşme et al (2005) compiled information on the numbers, sizes, qualities of active green areas of Muratpaşa, Kepez and Konyaaltı sub-municipalities and their neighborhoods in their study titled "An Evaluation of Green Spaces in Antalya City in Terms of Urban Green Spaces Functions" and profiled the existing green areas in the city. As a result, it was determined that the green areas do not show a regular distribution and there is no green space system setup throughout Antalya city. Manavoğlu and Ortaçeşme (2007) examined in detail the open and green areas within the Konyaaltı urban area located to the west of the city of Antalya within the scope of their work titled "A Green Space System Proposal for the Konyaaltı Urban Area". They evaluated the physical location of the region, taking into account the principles of open and green space planning, scientific research, and open and green space system practices in other countries. Manavoğlu and Ortaçeşme (2016) investigated the open and green areas within the borders of the adjacent area of Antalya city with the help of multi-criteria analysis in his study named "A Multi-Criteria Analysis of the Green Spaces in Antalya and the Development of Planning Strategies". Using LANDSAT Satellite images, they observed the land use change, system analysis of existing green areas and active green space analysis. As a result, they determined the rate of change in urban areas, forest areas and agricultural areas. Aklanoğlu (2007), in her article titled "The Effects of Climate Change on Landscape Design and Applications", investigated the contributions of open and green spaces to urban climate and to what extent climate is a factor affecting design in landscape designs. As a result, she emphasized the importance of plant species selection in open and green areas, maintenance activities should be carried out regularly, efficient use of water and consideration of climatic conditions in material selection are appropriate solutions.

Gómez-Muñoz et al. (2009) conducted their study titled "Effect of Tree Shades in Urban Planning in Hot-Arid Climatic Regions" where excessive solar heat was felt throughout the year. They concluded that large tree shades are more beneficial in terms of energy economy than small trees (Figure 1). The results show that enormous amounts of energy are saved all year round, with large trees able to provide up to 70% shade in spring and autumn. For this reason, it has been determined that the economic value of large trees is higher than their young species. Lin et al. (2010) carried out their studies named "Shading Effect on

Long-Term Outdoor Thermal Comfort" in a university campus in Taiwan (Figure 1). Using the PET (Physiological Equivalent Temperature) values calculated using the RayMan software, they analyzed the relationship between shade condition and comfort in the study area. As a result of this study, they determined that appropriate shading should be provided with trees and structural elements in order to increase thermal comfort in hot climatic regions in summer.



(a) **(b)**

Figure 1. (a) Results of "Effect of Tree Shades in Urban Planning in Hot-Arid Climatic Regions" (Gómez-Muñoz et al., 2009); (b) Results of "Shading Effect on Long-Term Outdoor Thermal Comfort" (Lin et al., 2010)

Hassaan and Mahmoud (2011) calculated PET (Physiological Equivalent Temperature) values for each area by dividing a city park in Cairo into 9 different regions in their study "Analysis of the

Microclimate and Human Comfort Conditions in an Urban Park in Hot and Arid Regions" (Figure 2). As a result of the study, it was determined that the hilly areas, the entrance area and the lake shores are the least preferred regions, the reason for this is that the temperature value is higher than the other regions due to the very few vegetal materials in these regions. In addition, the importance of taking into account the thermal requirements of the visitors and the regional climatic conditions was emphasized for the city parks to be designed in hot and arid regions.

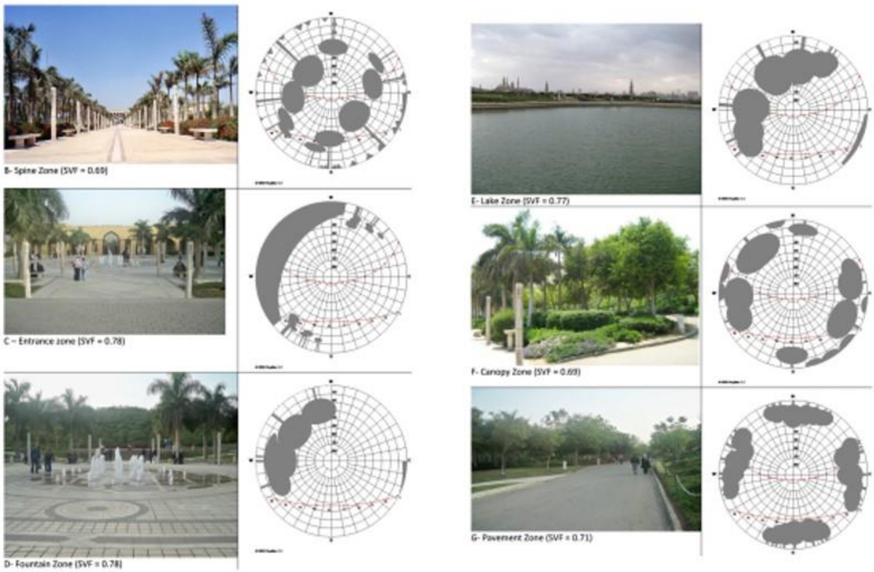
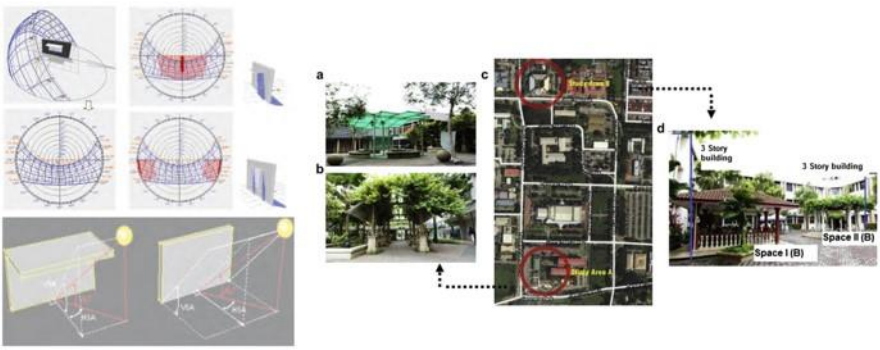


Figure 2. Results of "Analysis of the Microclimate and Human Comfort Conditions in an Urban Park in Hot and Arid Regions" (Hassaan and Mahmoud, 2011)

Lin et al. (2012) conducted a survey using micrometeorological measurements in a city park in Taiwan in their study "Effects of

Thermal Comfort and Adaptation on Park Attendance Regarding Different Shading Levels and Activity Types". In this study conducted in different seasons, they analyzed the thermal comfort conditions using the PET (Physiological Equivalent Temperature) model. As a result of the study, they revealed that the shaded areas formed in the parks cause the number of visitors to decrease during the cool seasons and to increase in the hot seasons. Yılmaz et al. (2013) emphasized how climatic conditions affect design and the importance of climate-dependent designs in their article titled "Exploring Climate-Based Design Opportunities Under Hot Climate Conditions, The Example of Antalya Cumhuriyet Square". In the study carried out specifically for Antalya Cumhuriyet Square, which has an intensive use, it is explained with examples how the design is shaped depending on the climate in hot climatic conditions, how hard floors, grass areas, urban reinforcements, the use of water elements and vegetative design differ according to other climate types. Görcelioğlu (1986), in his work titled "Evaluation of Sun Angles in Landscape Arrangements", mentioned that the direction of arrival of the sun rays at certain times of the year and day in a certain place can be easily calculated and by taking this into account, landscape applications will be made more consciously and accurately. He gave information about the importance of trees in design and the benefits they provide when used in the right places. Ataberk (1996), in her study named "Computer Aided Shadowing Effect Analysis of Buildings", the shadow effects of buildings on neighboring buildings were investigated with the support of a computer program. In the study, it is aimed to create an architectural tool that can be used in the preliminary design stage in order to reach the maximum sun of each unit in the urban space. Yılmaz and Memluk (2008) prepared numerical maps related to the study area in their work titled “In valley design facilities according as movements of wind and sun, a case study of Ankara Buyukesat Valley”. The movements of the sun on the field throughout the year were created with computer-aided animations and the duration of sunbathing and the shadow lengths of the structures were calculated. In this study, wind and solar movements of Ankara Büyükesat Valley were examined and design possibilities related to these were investigated.

Yüceer (2010), in her study named "An Approach to Shading Device Design: the Case of Adana", made the shape and size analysis of shadow elements with the shadow analysis program (Solar tool) (Figure 3). She examined how the most appropriate shade element design should be that can be applied to the buildings in Adana by evaluating many variables such as window dimensions, solar geometry and climate data. Armson et al. (2012), in their study called "The Effect of Tree Shade and Grass on Surface and Globe Temperatures in an Urban Area" in Manchester, England, examined the effects of trees and grass areas in the urban landscape on the temperature in summer. As a result of the study, they found that tree shading reduces the ambient temperature by 5-7 ºC and the air temperature by 1-2 C, grass and ground covers are also effective in reducing the ambient temperature, and as a result, this situation positively affects human comfort. Makaremi et al (2012) used climatic parameters and questionnaire method to investigate the thermal comfort conditions of the study area in their study named “Thermal Comfort Conditions of Shaded Outdoor Spaces in Hot and Humid Climate of Malaysia” (Figure 2). As a result of the study, they determined that environmental factors, thermal adaptation and psychological parameters have a great effect on the thermal comfort of individuals in the open area.



(a) **(b)**

Figure 3. (a) Resuls of "An Approach to Shading Device Design: the Case of Adana" (Yüceer, 2010); (b) Resuls of “Thermal Comfort Conditions of Shaded Outdoor Spaces in Hot and Humid Climate of Malaysia” (Makaremi et al, 2012)

Gezer (2003), in his study named "The Effects of Construction Materials on Thermal Comfort in Residental Buildings An Analysis Using Ecotect 5.0", collected data from three different houses in Yozgat, and examined the effect of the material on thermal comfort with the help of Ecotect 5.0. As a result of the study, it was determined that the building material affects the building performance and thermal comfort in naturally ventilated buildings. Andreou (2014), in his article "The Effect of Urban Layout, Street Geometry and Orientation on Shading Conditions in Urban Canyons in the Mediterranean", used shading simulations of urban canyons on two streets in Greece, which show different character in terms of street geometry and urban density. In this study, which aims to determine the effects of parameters such as street geometry, direction and urban density under shading conditions, Autodesk Ecotect Analysis programs were used for shadow analysis. As a result, the results of shading simulations were compared with experimental measurement results of air and surface temperatures and parametric thermal analysis results. It was determined that the traditional settlement morphology in the area showed the most positive results.

Yang et al. (2014), in their study named "Application Research of ECOTECT in Residential Estate Planning", drew attention to the rapid development of living standards and economy in recent years and building energy consumption constitutes 46.7% of all consumption (Figure 4). In this study based on the Ecotect software, some useful data were obtained in terms of land planning of the settlements. In the study conducted in Anhui province in Ma'anshan city of China, factors such as building orientation, daylight and natural ventilation conditions were analyzed with meteorological data and energy saving strategies. With the Ecotect software, various ecological methods have been developed to save energy at the early design stage. Yücekaya (2017) developed a method proposal to determine the microclimatic contribution of urban open spaces to the city in his research titled "An analytic model proposal to design with climate of urban open spaces: A case study of Gaziantep". In the study, bioclimatic comfort maps of Gaziantep province were created and simulations were developed using ENVI-met software. As a result, it has been concluded that increasing the green areas and their balanced distribution in the city will increase bioclimatic comfort, increase the temperature stress of high-rise buildings, and hard floors have a negative effect on temperature.

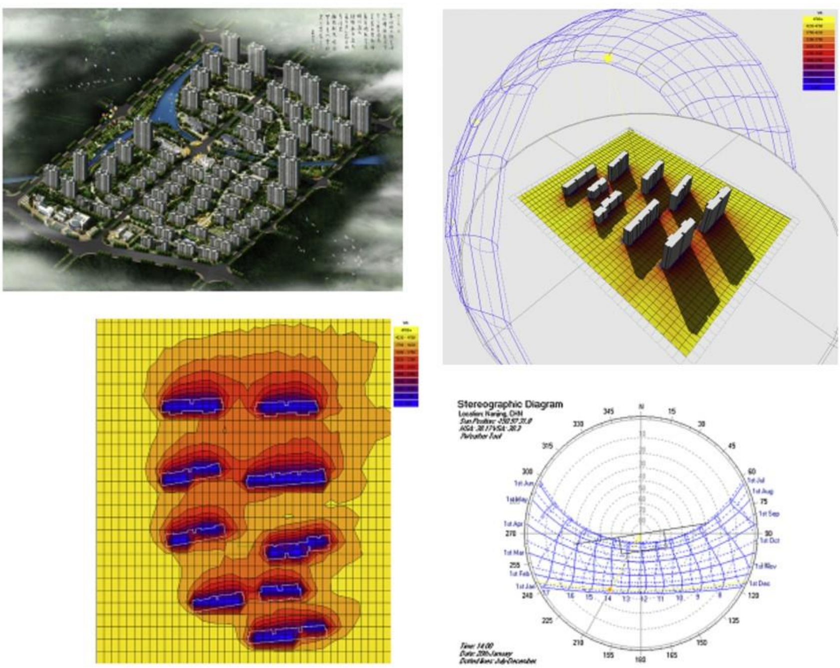


Figure 4. Results of "Application Research of ECOTECT in Residential Estate Planning" (Yang et al., 2014)

Boz (2017), in her study titled “Bioclimatic comfort values analysis of city central of Tekirdağ”, determined 19 points by random selection method and analyzed temperature values in morning, noon and evening and humidity and wind measurements from these points. The obtained data were analyzed by ArcGIS program with Inverse Distance Weighted Interpolation Technique for bioclimatic comfort and temperature, humidity and wind maps were created. As a result of the study, it was revealed that the months of March, April, September and October are the best months in terms of comfort. Çetin (2019) investigated the effects of natural elements and existing urban land on biocomfort in her study titled "The evaluation in terms of bioclimatic comfort of the province of Trabzon". In this study, besides satellite images, climate stations were used, and it was concluded that the factors affecting the city's urban islands are concentrated in the northern parts of the city. It has been revealed that the reason for this is due to the topography and the density of industry and housing, and that there is a relationship between the land surface temperature and the vegetation index. According to the results of the study, the reduced vegetation causes the surface temperature of the city to increase. Yılmaz (2020) has created data typologies by making detailed climate analysis of the Süleymanbey District of Yalova in her research titled “Bioclimatics in outdoor design parameters effect: Yalova example”. According to the results of the study, climatic comfort criteria can be affected by many parameters that are related and not related to the individual's own qualities. It has been concluded that individuals' bioclimatic comfort conditions can be increased with the principles and criteria applied in planning and designs.

Studies on seasonal shade effects in open and green areas in Turkey are extremely limited. Applications for planting open and green areas in our country include determining plant taxon groups in various cities, examining existing species in terms of vegetative design and determining suitable taxa for the area. It has been observed that studies on the shade effect are mostly limited to structural and interior analysis. One of such design examples is Shanghai Natural History Museum (Figure 5).

Figure 5. Shanghai Natural History Museum (URL-1)

In addition, Singapore National Library, Singapore Fusionopolis Business Park-Solaris Office Building, China West Kowloon Cultural District can be given as applied examples (Figure 6).

Figure 6. Applied design examples (URL-1)

3. CONCLUSION

Nowadays, with the increase in construction, open and green areas, which have gained importance compared to the past, are areas that have become a basic requirement, where individuals get away from the stress of daily life and spend quality time, meet their recreational needs. Therefore, the existence of open and green areas is a necessity in terms of public health as well as urban health. Especially for individuals living in cities, the proximity of the place where they live to green areas that are actively used has always been a reason for preference. This is actually a reflection of human beings' longing for natüre (Durdu, 2015). Since the campuses are located in the inner city or its close environment, they are evaluated within the open and green area system of the city. For this reason, the right designs to be made in the campuses will play an enormous role in increasing the comfort levels of both the people of the city and the campus users.

The goal of the designers should be to provide the comfort required for human life in the built environment, indoors and outdoors. Climatic factors affect human comfort and the climatic structure of the place should be well known in order to create outdoor spaces where people feel comfortable. After having this knowledge, more rational solutions can be produced in design (Şahin and Dostoğlu, 2007).

The technology used for comfort, which is tried to be provided later in designs made without giving importance to the climate, is both very costly and not able to provide the required performance. For this reason, climate at the building and urban space level should be evaluated at the beginning of the design as a basic data and the spatial order should be considered within this framework. However, unfortunately, many cities today have not been shaped as a result of such a process. It is important to use climatic data in creating building layouts for new settlements. It is important and necessary to provide a solution for the different effects that occur as a result of lack of planning in urban spaces that are not realized within the framework of this understanding. For this reason, the necessary comfort conditions should be provided outdoors by making arrangements for protection or benefit. Thus, livable spaces outside the buildings can be created for the users with the effect of the microclimate created (Şahin and Dostoğlu, 2007).

Landscape and building forms can change the microclimate on a large or small scale. Planting is preferred for various reasons in microclimate control. Plants are absorbing and reflective of the sun's rays. Trees create cool shadows under them, while reducing the ambient temperature in the summer, they allow the sun rays to reach during the winter. In addition, a cooling effect is created thanks to the evaporation on the leaf surfaces (Oktay 2001).

The importance of open and green spaces is increasing day by day. Therefore, trees are seen as a part of the urban landscape, and the presence of trees in urban spaces adds a universal city feature to settlements. Open and green areas fulfill many ecological, economic, aesthetic, recreational and psychological functions in campus designs (Yılmaz and Irmak, 2012; Aksu and Yılmaz, 2018). For these reasons, correct applications should be made and correct design approaches should be developed in order to increase the comfort level in campus designs.

Acknowledgement: This study is part of an individual research project supported by Siirt University Coordinatorship of Scientific Research Projects with the project number 2021-SİÜZİR-027.

REFRENCES

Aklanoğlu, F. (2007). İklim değişikliğinin peyzaj tasarımı ve uygulamaları üzerine etkileri. Uluslararası Küresel İklim Değişikliği ve Çevresel Etkileri Konferansı 18 - 20 Ekim Koski ve Selçuk Üniversitesi, Konya Büyükşehir Belediyesi, Konya, 93- 102.

Aksu, A., Yılmaz, H. (2018). Atatürk Üniversitesi Merkezi Açık-Yeşil Alandaki Fiziki Değişim Memnuniyetinin Belirlenmesi. Iğdır Ünv. Fen Bilimleri Ens. Der. 8(2): 231-237.

Armson D., Stringerb P., Ennosa A.R. (2012). Urban forestry and Urban greening 11 (2012) 245– 255.

Ataberk, E. (1996). Computer aided shadowing effect analysis of buildings, Orta Doğu Teknik Üniversitesi Fen Bilimleri Enstitüsü, Ankara, 93 s.

Attia S., Duchhart I. (2011). Bioclimatic landscape design in extremely hot and arid climates, Passive and Low Energy Architecture (PLEA) Conference, July, Louvaın la Neuve, Belgium.

Bulğan, E. (2014). Erzurum kentinde farklı kent dokularının yaz aylarında biyoklimatik konforunun hesaplanması. Yüksek lisans tezi, Atatürk Üniversitesi Fen Bilimleri Enstitüsü, Erzurum.

Cohen P, Potchter O, Matzarakis A. (2013). Human thermal perception of coastal Mediterranean outdoor urban environments. Applied Geography 37: 1–10.

Datta G., 2001. Effect of fixed horizontal louver shading devices on thermal performance of building by TRNSYS simulation. Renewable Energy 23 (2001) 497–507.

Demircan, M, H. Arabacı, Bölük E., Akçakaya A., Şensoy S., Ekici M. (2013). İklim normalleri ve 1981-2010 sıcaklık normallerinin coğrafî bilgi sistemleri ile topografya kullanarak yüksek çözünürlüklü grid veri setinin üretilmesi. 6. Atmosferik Bilimler Sempozyumu, İstanbul Teknik Üniversitesi, İstanbul, s. 1-11.

Durdu, S. (2015). Açık Yeşil Alan Tasarımında Mevsimsel Gölge Etkisinin İrdelenmesi: Çayırlı Mustafa Karabulut Parkı Örneği. Yüksek lisans tezi, Akdeniz Üniversitesi Fen Bilimleri EnstitüsüPeyza Mimarlığı Anabilim Dalı, 169 s., Antalya.

Gezer, N.A. (2003). The effects of construction materials on thermal comfort in residental buildings; an analysis using ecotect 5.0. Orta Doğu Teknik Üniversitesi Fen Bilimleri Enstitüsü Mimarlık Bölümü, Yüksek Lisans Tezi, Ankara, 119 s.

Görcelioğlu, E. (1986). Peyzaj düzenlemelerinde güneş açılarının değerlendirilmesi. *İstanbul Üniversitesi Orman Fakültesi Dergisi,* Seri: B, 36(4), İstanbul.

Gómez-Mu˜noz V.M., Porta-Gándarab M.A., Fernándezc J.L. (2009). Effect of tree shades in urban planning in hot-arid climatic regions. Landscape and urban planning 94 (2010) 149–157.

Gül A., Küçük V. (2001). Kentsel açık- yeşil alanlar ve Isparta kenti örneğinde irdelenmesi. *Süleyman Demirel Üniversitesi Orman Fakültesi Dergisi*. Sayfa: 27-48.

Hassaan A., Mahmoud A. (2011). Analysis of the microclimatic and human comfort conditions in an urban park in hot and arid regions. Egypt, 46: 2641-2656.

Johansson E. (2006). Urban design and outdoor thermal comfort in warm climates. Ph.D. thesis, Lund University Press, Sweden.

Lin TP, Matzarakis A, Hwang RL. (2010). Shading effect on long-term Outdoor Thermal Comfort. *Building and Environment*, 45: 213-221.

Lin TP., Tsai KT., Liao CC., Huang YC. (2012). Effects of thermal comfort and adaptation on park attendance regarding different shading levels and activity types. *Building and Environment,* 1-13.

Makaremi, N., Salleh, E., Jafaar, M.Z., Ghaffarianhoseini, A. (2012). Thermal comfort conditions of shaded outdoor spaces in hot and humid climate of Malaysia. *building and environment,* 48: 7- 14

Manavoğlu, E., Ortaçeşme, V. (2007). Konyaaltı kentsel alanında bir yeşil alan sistem önerisi geliştirilmesi, *Akdeniz Üniversitesi Ziraat Fakültesi Dergisi*, Antalya, 20(2): 261-271.

Manavoğlu, E, Ortaçeşme, V. (2016). Antalya kenti yeşil alanlarının çok ölçütlü analizi ve planlama stratejilerinin geliştirilmesi. *Akdeniz Üniversitesi Ziraat Fakültesi Dergisi,* 28 (1) , 0-0.

Oke, T.R. (1988). Street design and urban canopy layer climate. Energy and buildings, 11(1): 103-113.

Oke, T.R. (2006). Towards better scientific communication in urban climate. Theoretical and Applied Climatology, 84(1-3): 179-190.

Oktay, D. (2001). Planning Housing Environments For Sustainability, İstanbul: Yapı Endüstri Merkezi yayınları, 127 s.

Olgyay, V. (1973). Design with climate, bioclimatic approach to architectural regionalism. Princeton University Press, New Jersey.

Ortaçeşme, V., Yıldırım, E., Manavoğlu, E. (2005). Kentsel yeşil alan fonksiyonları düzleminde Antalya kenti yeşil alanlarına bir bakış, Antalya Yöresinin İnşaat Mühendisliği Sorunları Kongresi, cilt.2, ss.539-549, 22-24 Eylül Antalya.

Pauleit S, Ennos R, Golding Y. (2005). Modeling the environmental impacts of urban land use and land cover change—a study in Merseyside, UK. Landscape and Urban Planning, 71(2): 295-310.

Priyadarsini R, Hien WN, Wai David CK. (2008). Microclimatic modeling of the urban thermal environment of Singapore to mitigate urban heat island. Solar energy, 82(8): 727-745.

Şahin, E., Dostoğlu, N. (2007). Kentsel Mekan Tasarımında Doğal Verilerin Kullanımı. *Uludağ Üniversitesi Mühendislik-Mimarlık Fakültesi Dergisi*, 12(1): 29- 40.

Toy, S., Yılmaz, S. (2009). Peyzaj tasarımında biyoklimatik konfor ve yaşam mekanları için önemi. *Atatürk Üniversitesi Ziraat Fakültesi Dergisi*, 40(1): 133-139.

Whitford V., Ennos A.R., Handley J.F. (2001). City form and natural processes: indicators for the ecological performance of urban areas and their application to Merseyside, UK. Landscape and Urban Planning, 20: 91–103.

Yalçın, G., Demircan, M., Ulupınar, Y., Bulut, E. (2005). Klimatoloji – I. DMİ Yayınları, Ankara.

Yang, F., Lau, S.Y., Qian, F. (2011). Thermal comfort effects of urban design strategies in high-rise urban environments in a sub-tropical climate. Architectural Science Review, 54(4): 285-304.

Yang, L., He, B.J., Ye, M. (2014). Application research of ecotect in residential estate planning. *Energy and Buildings*, 72: 195- 202.

Yılmaz, T., Memlük, Y. (2008). Vadilerde rüzgâr ve güneş hareketlerine bağlı planlama ve tasarım olanakları, Ankara Büyükesat Vadisi örneği. *Akdeniz Üniversitesi Ziraat Fakültesi Dergisi,* 21(2): 193–204.

Yılmaz, H., Irmak, M.A. (2012). Yerleşke planlamasında Bitkisel Tasarım İlkeleri; Atatürk Üniversitesi Yerleşkesi Örneği. Atatürk Üniv. Yayın No:1011, Erzurum, Türkiye. 192s

Yılmaz, T., Şavklı, F., Yıldırım, E. (2013). İklime bağlı tasarım olanaklarının sıcak iklim koşullarında irdelenmesi, Antalya Cumhuriyet Meydanı örneği. *Türk Bilimsel Derlemeler Dergisi*, 6 (1): 42-45.

Yılmaz, M. (2020). Dış mekan tasarımında biyoklimatik parametrelerin etkisi "Yalova örneği". Yüksek lisans tezi. Gebze Teknik Üniversitesi Fen Bilimleri Enstitüsü, Şehir ve Bölge Planlama Ana Bilim Dalı, 176 s.

Yüceer, N. (2010). Gölge elemanı tasarımına bir yaklaşım ve Adana örneği. METU JFA 2010/2 (27:2) 1-13.

Zhao, C., Fu, G., Liu, X., Fu, F. (2011). Urban planning indicators, morphology and climate indicators: A case study for a north-south transect of Beijing, China. Building and Environment, 46(5): 1174–1183.

URL 1. https://www.emaze.com/@ACWTOOTC Accessed Date: 08.04.2021

CHAPTER 12

EVALUATION OF THE BIOCLIMATIC COMFORT OF THE GREEN AREAS IN FETHİYE CITY CENTER

Assoc. Prof. Dr. İsmail ÇINAR [1*]
Assist. Prof. Dr. Zeynep Rabiye ARDAHANLIOĞLU [2]
Assoc. Prof. Dr. Rifat OLGUN [3]

[1*] Muğla Sıtkı Koçman University, Vocational School of Fethiye Ali Sıtkı Mefharet Koçman, Department of Park and Horticulture, Muğla, Turkey. E-mail: icinar@mu.edu.tr ORCID ID: 0000-0002-0234-0178

[2] Muğla Sıtkı Koçman University, Vocational School of Fethiye Ali Sıtkı Mefharet Koçman, Department of Park and Horticulture, Muğla, Turkey. E-mail: zeyneprb@mu.edu.tr ORCID ID: 0000-0002-5571-1008

[3] Akdeniz University, Vocational School of Serik Gülsün-Süleyman Süral, Department of Park and Horticulture, Antalya, Turkey. E-mail:rifatolgun@akdeniz.edu.tr ORCID ID: 0000-0002-5396-057X

INTRODUCTION

Rapid changes in industry and technology developing due to rapid population growth have led to the emergence of unplanned urbanization. Urban areas, which are the most important reason for incorrect land use, cannot have a healthy urban structure if they are not planned correctly. People living in the city are adversely affected by this situation. The importance of open green areas, one of the most important parts of urban areas, is increasing day by day. Especially, urban green areas are of great importance because they create a balance (establish an organic relationship) between people and the environment, providing masses and spaces balance in the city, and regulate the climate of their location (Gül and Küçük, 2001; Selim et al., 2014; Çınar et al, 2015). According to Acar and Sarı (2005), the number of people living in cities is assumed to reach 2/3 of the entire population by 2025. This situation shows that urban green spaces will be even more important in the future.

Various definitions have been made by landscape architects and other professional disciplines regarding open green spaces. Open spaces are one of the basic elements of the urban texture and are defined as openings or free spaces outside the architectural structure and transportation areas (Gül and Küçük, 2001). In another definition, the open area is the part of the city where people live, built on, excluded from closed extensions or left in a natural state, reserved for agricultural and non-residential recreational areas (Özdamar, 2006). Green area is defined as the surface areas of the existing open areas covered or combined with plant materials (Gül and Küçük, 2001). In this respect, open green areas have become one of the areas used by the citizens of the city for daily active and passive recreational activities (Özer and Karakuş, 2012; Karakuş, 2016).

Open green areas in urban spaces are an important component of urban life quality and are important for the healthy development of cities. Since cities are areas where movements based on human activities are very intense, pressure on natural areas in the inner city and its periphery is also increasing (Mansuroğlu et al., 2005; Emür and Onsekiz, 2007; Üstündağ et al., 2011; Selim et al., 2014; Çınar et al., 2015). These pressures on natural areas reduce the quality of urban life by disrupting the structure of the urban ecosystem (Bolund and Hunhammer, 1999). While green areas play an important role in protecting the health of the ecosystem and the environment, they also meet many needs of people living in cities. Some of these can be listed as ensuring the physical balance of cities, limiting urban development, bringing microclimatic features to the city, offering recreational opportunities, and enriching the aesthetics of the city (Öztan, 1968). Plants used in urban green areas have a positive effect on the climate of the location besides their aesthetic beauty. In addition, these plants become an important carbon well in the struggle against climate change. Especially, trees are the most important carbon well in the terrestrial ecosystem since their biomass is more than other plants (Yücel et al., 2009; Karakuş, 2010; Karakuş and Yücel, 2011).

Many studies have been conducted to show the importance of green spaces on urban climate and to determine the bioclimatic comfort provided by green spaces (Thorsson et al., 2007; Zoulia et al., 2009; Bowler et al., 2010; Cohen et al., 2012; Jamei et al., 2016; Hami et al., 2019; Yang et al., 2019; Arghavani et al., 2020; Yücekaya and Uslu; 2020). Open green areas contribute positively to the climate of the region where they are located. Because of these positive effects, they are of great importance. The climatic conditions of the regions have a limiting effect on people's activities. (Rudel et al., 2007). The notion of bioclimatic comfort deals with the effect of outdoor climate parameters on people individually or collectively (Toy and Yılmaz, 2008). Recently, studies on providing bioclimatic comfort conditions that will enable people to breathe and live more comfortably are increasing. The common purpose of the studies are to prepare the environment that will provide a more comfortable and enjoyable life for people (Kestane and Ülgen, 2013).

In this context, the aim of the study is to evaluate the bioclimatic comfort situation of the green areas consisting of parks and recreation areas in Fethiye city center.

1. MATERIAL AND METHOD

The city center of Fethiye district of Muğla province was determined as the research area (Figure 1). Fethiye, southwest of Anatolia, is surrounded by Kaş district and the Çayağzı where the Eşen Stream flows into the Mediterranean in the south, Kapıdağ Peninsula and

Dalaman in the west, Seydikemer in the east, Gölhisar and Çameli districts in the north. In addition, it is a typical coastal city within the Mediterranean region of the line that separates the Mediterranean region and the Aegean region (Özer et al., 2013; Ardahanlıoğlu and Karakuş, 2016; Özer et al., 2016; Ardahanlıoğlu et al., 2018).

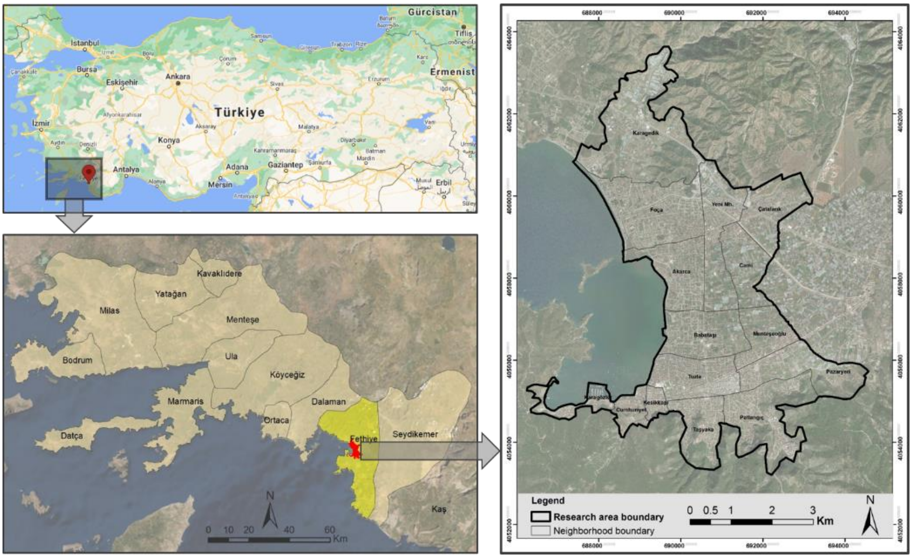


Figure 1. Location of the research area

According to previous studies conducted in Fethiye city center, the city center includes 15 neighbourhoods. (Karakuş et al., 2014; Selim et al., 2014; Çınar et al., 2015; Selim and Karakuş, 2016). In this context, the study was carried out in 15 neighborhoods in Fethiye city center. The main materials of the study are the parks in 15 neighbourhoods in Fethiye city center and the data of Fethiye, Dalaman and Seydikemer meteorology observation stations. In addition, researches on open green space, bioclimatic comfort and Fethiye region constitute the other materials of the study.

The development plan (1/1000 scale) obtained digitally from Fethiye Municipality was first arranged on a neighbourhood scale in the NetCAD program and the research area boundary required for the study, the neighborhood boundary, and the applied park data were filtered. The filtered data were placed in the world coordinates according to the WGS_1984_UTM_Zone_35N coordinate system in the ArcGIS software.

The data of climatology observation stations in Dalaman, Fethiye and Seydikemer districts were used to determine the bioclimatic comfort of the parks in the study area (Figure 2). Dalaman meteorology observation station is at 36.7719 N, 29.7986 D coordinates, Fethiye meteorology observation station is at 36.6266 N, 29.1238 D coordinates, and Seydikemer meteorology observation station is at 36.8764 N, 29.6642 E (Fig 2).

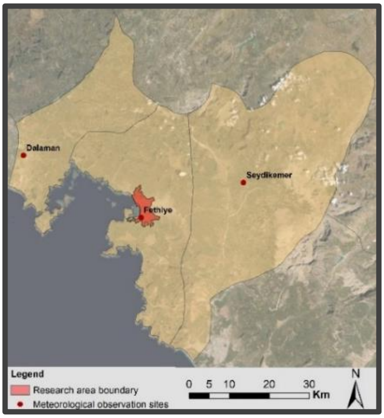


Figure 2. Meteorolocigal observation sites

According to the statement of Olgay (1973), bioclimatic comfort in the Mediterranean Climate Zone deteriorates mostly during the day between May and October months. In this context, climate data (temperature, wind, cloudiness, relative humidity) for the between May and October months were obtained from Dalaman, Fethiye and Seydikemer climatology observation stations. (Table 1).

Table 1. Meteorology Observation Sites Monthly Average Data

Meteorological observation sites		**May**	**Jun**	**Jul**	**Aug**	**Sep**	**Oct**	**Annual average**
Dalaman	Average Temperature (°C)	19,9	24,5	26,8	26,6	23,3	18,8	17,9
	Average Relative Humidity (%)	59,0	48,0	41,0	42,0	48,0	61,0	61,0
	Average Cloudiness (1/8)	3,7	1,8	0,8	0,8	1,4	3,3	3,6
	Average Wind Speed (m/s)	2,2	2,7	2,6	2,2	2,1	1,9	
Fethiye	Average Temperature (°C)	20,5	24,8	27,5	27,4	24,0	19,2	18,4
	Average Relative Humidity (%)	74,0	71,0	70,0	70,0	79,0	75,0	75,0
	Average Cloudiness (1/8)	3,2	1,6	0,7	0,8	1,2	3,0	3,2
	Average Wind Speed (m/s)	1,4	1,6	1,7	1,5	1,4	1,3	1,4
Seydikemer	Average Temperature (°C)	20,3	26	30	28	24	18	24,3
	Average Relative Humidity (%)	65	53	42	59	57	68	57,3
	Average Cloudiness (1/8)	2	1	0,4	0,6	1	2	1,2
	Average Wind Speed (m/s)	1.6	1,7	1,8	1,6	1.6	1.6	1.7

As in many previous studies, Physiological Equivalent Temperature (PET) was obtained by analyzing monthly average temperature, humidity, wind speed and cloudiness data with RayMan software (Matzarakis et al., 1999; Cohen et al., 2012; Topay, 2012; Topay, 2013; Çınar et al., 2016; Çınar et al., 2017; Çınar et al., 2019; Libanda et al., 2020). The PET values obtained from the stations (Dalaman, Fethiye and Seydikemer) were transferred to the GIS software. Monthly bioclimatic comfort maps of the parks between May and October were created on a spatial scale by performing IDW analysis in the GIS software. The obtained maps were classified and bioclimatic comfort conditions of the parks were evaluated. In addition, in the general evaluation of bioclimatic comfort, bioclimatic comfort criteria determined by Matzarakis et al. (1999) were used (Table 2).

Tablo 2. Thermal detection and PET values (Matzarakis et al., 1999).

PET (°C)	Thermal Detection	Physiological Stress Categories
<4	Very cold	Extreme cold stress
4 – 8	Cold	Very cold stress
8 – 13	Cool	Moderate cold stress
13 – 18	Slightly cool	Mild cold stress
18 – 23	**Comfartable**	No thermal stress
23 – 29	Slightly worm	Mild heat stress
29 – 35	Warm	Moderate heat stress
35 – 41	Hot	Very hot stress
>41	Very Hot	Extreme heat stress

2. RESULTS AND DISCUSSION

In the study, existing recreation areas, urban and neighbourhood parks in the city center of Fethiye district that are actively used by the public were examined. Fethiye city center consists of 15 neighbourhoods (Figure 3). The number of applied parks that are actively used by the public in Fethiye city are the highest in Tuzla Neighbourhood and the least in Karagedik Neighbourhood.

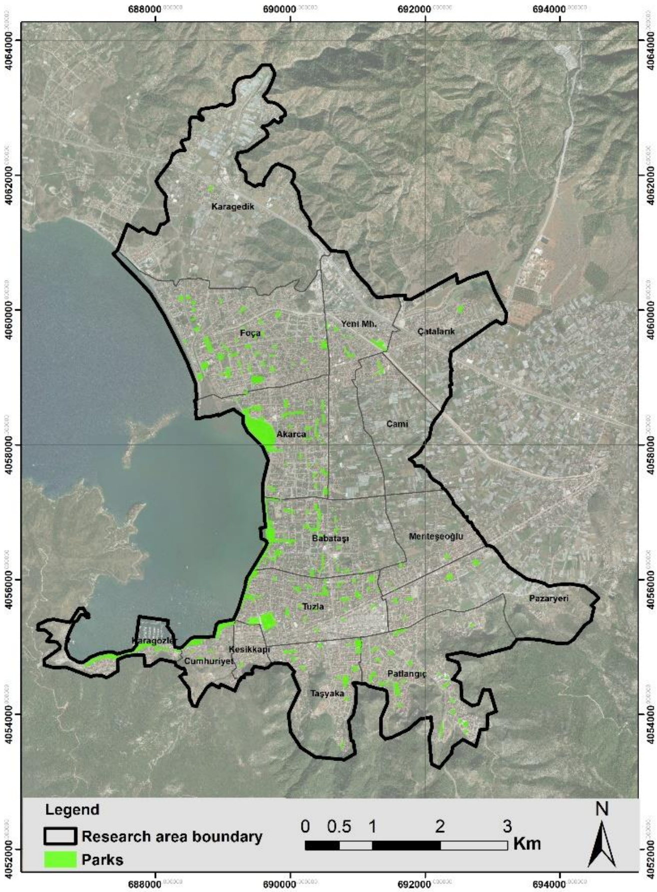


Figure 3. Parks in the research area

In analyzing the bioclimatic comfort, the climate data of each meteorology station were loaded into the RayMan software and PET values were obtained as a result of the analysis. The PET values obtained were transferred to the database created in the GIS software. PET data were distributed spatially by IDW analysis in GIS software. Then, the PET data in the areas with parks were masked and only the data of the parks were obtained. This process was repeated every month.

The PET values of the parks obtained for May are between 28.9 - 29.7 °C. Mild and moderate heat stress is observed at the parks in Fethiye city center in May (Figure 4).

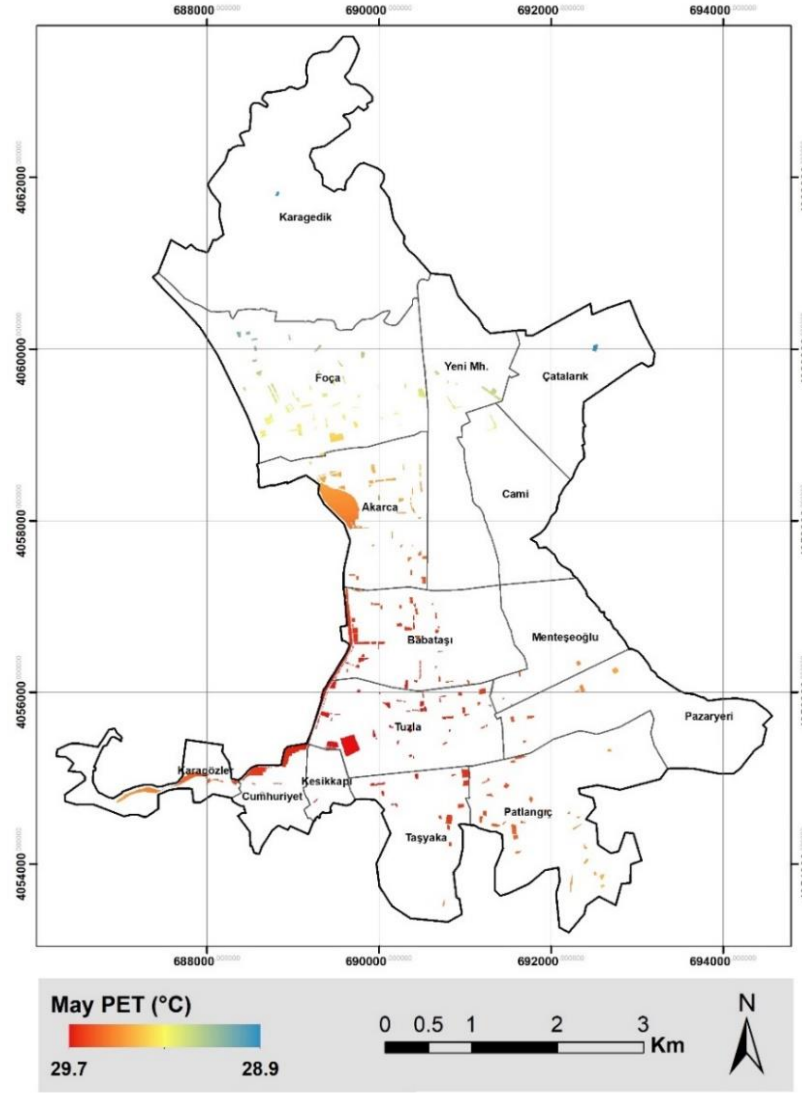


Figure 4. PET for the month of May

The PET values of the parks obtained for June are between 33.5 - 33.7 °C. At the parks in Fethiye city center, moderate heat stress is observed in June (Figure 5).

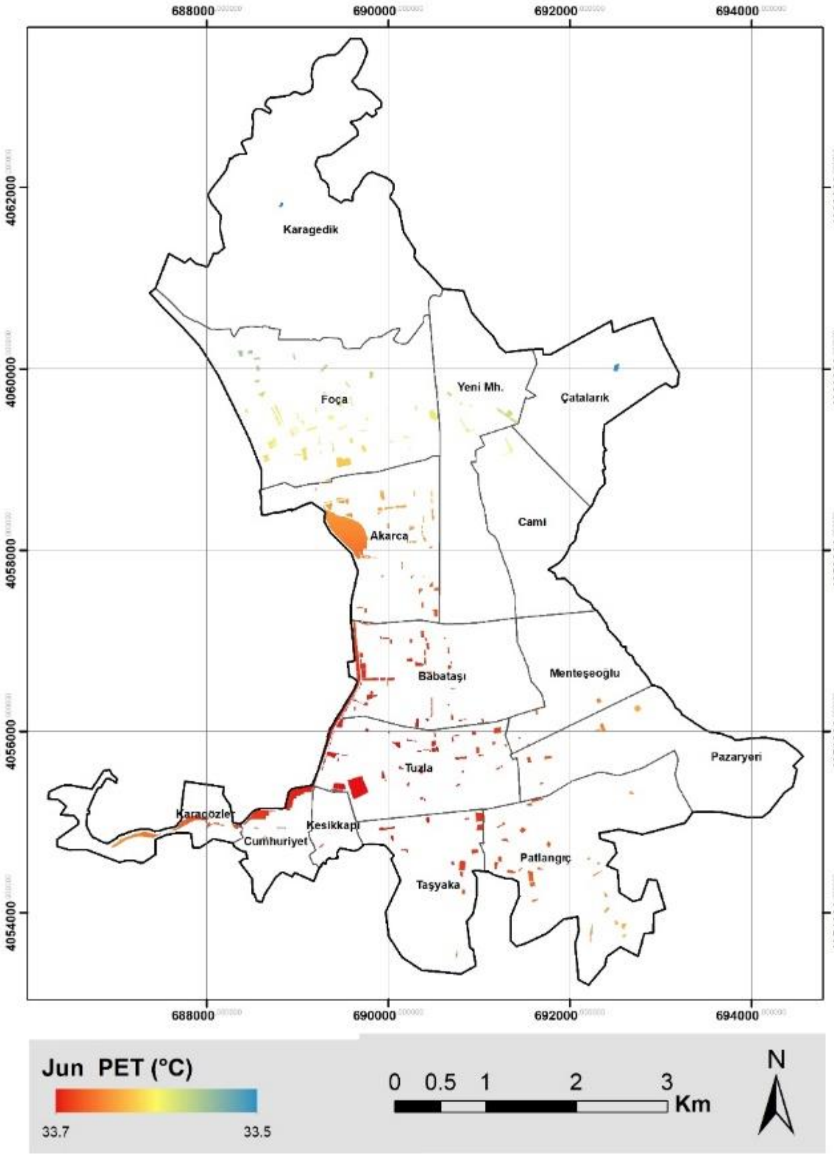


Figure 5. PET for the month of Jun

The PET values of the parks obtained for July are between 41.7 - 42.4 °C. At the parks in Fethiye city center, extreme heat stress is observed in July (Figure 6).

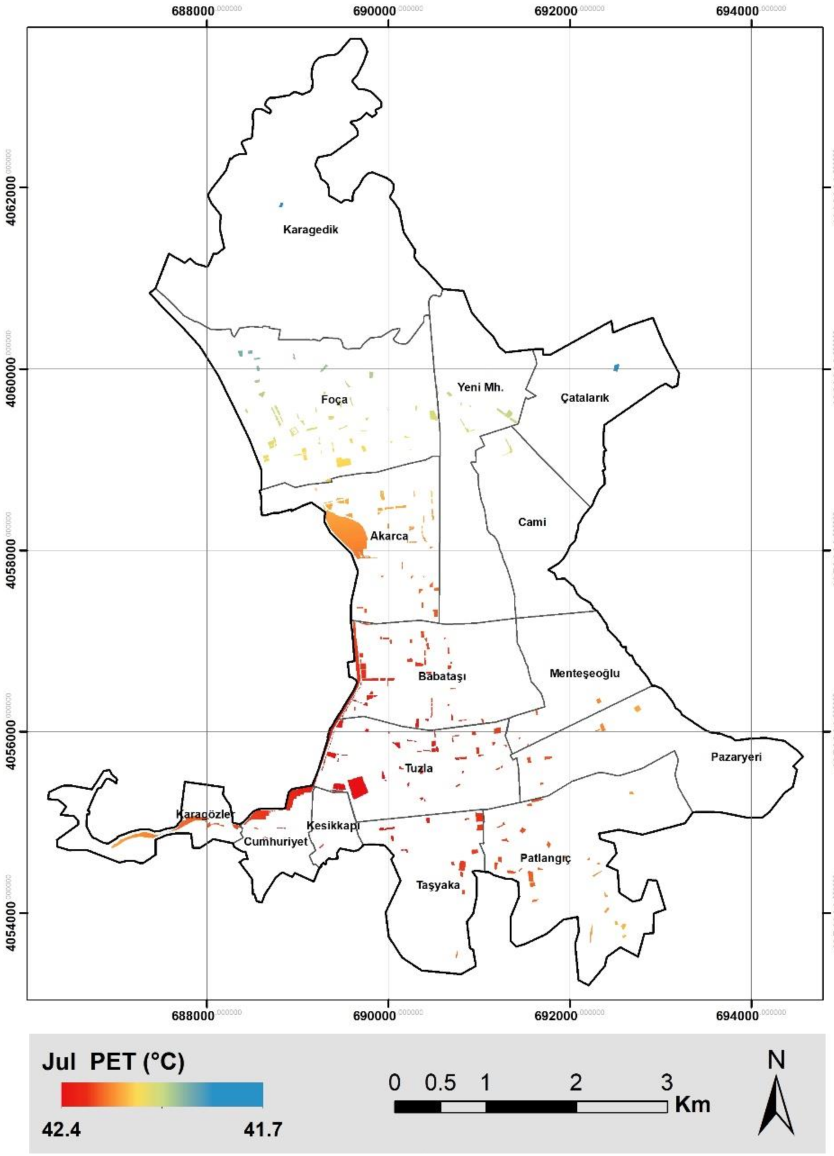


Figure 6. PET for the month of July

The PET values of the parks obtained for August are between 41.5 - 42.4 °C. At the parks in Fethiye city center, extreme heat stress is observed in August (Figure 7).

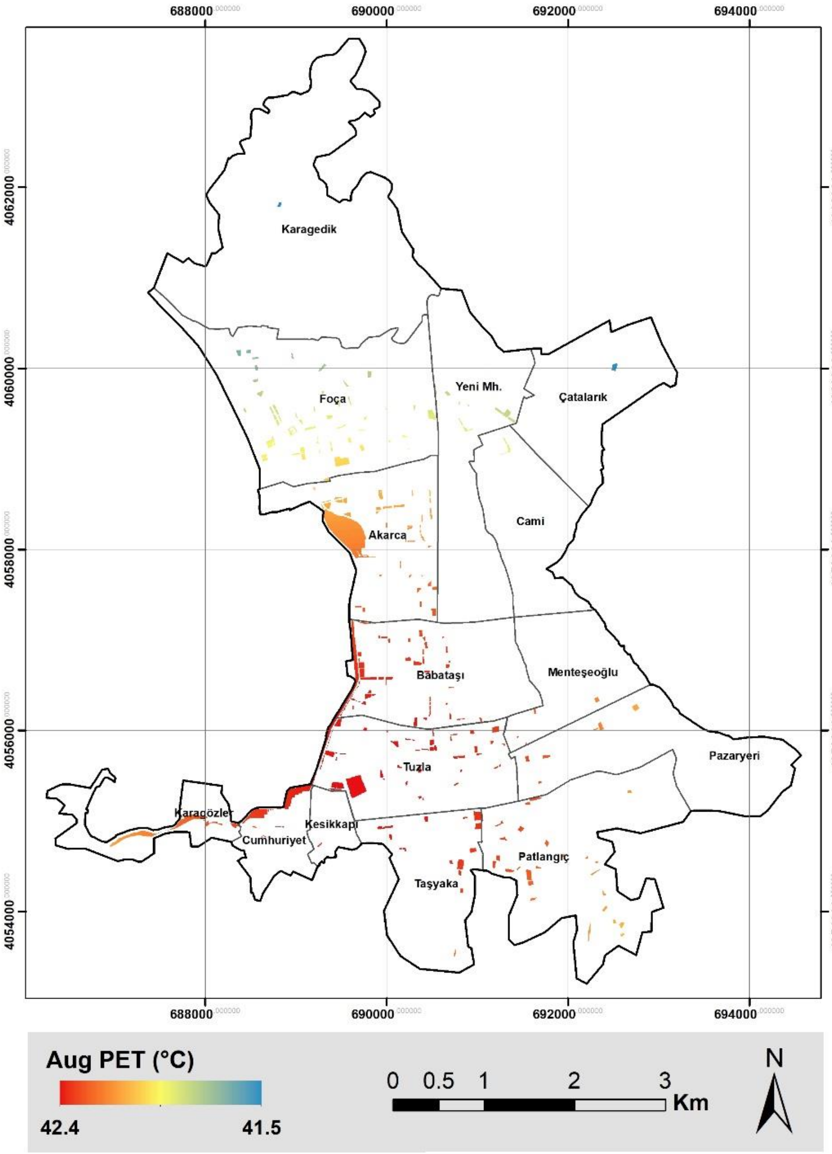


Figure 7. PET for the month of August

The PET values of the parks obtained for September are between 41.7 - 41.9 °C. At the parks in Fethiye city center, extreme heat stress is observed in September (Figure 8).

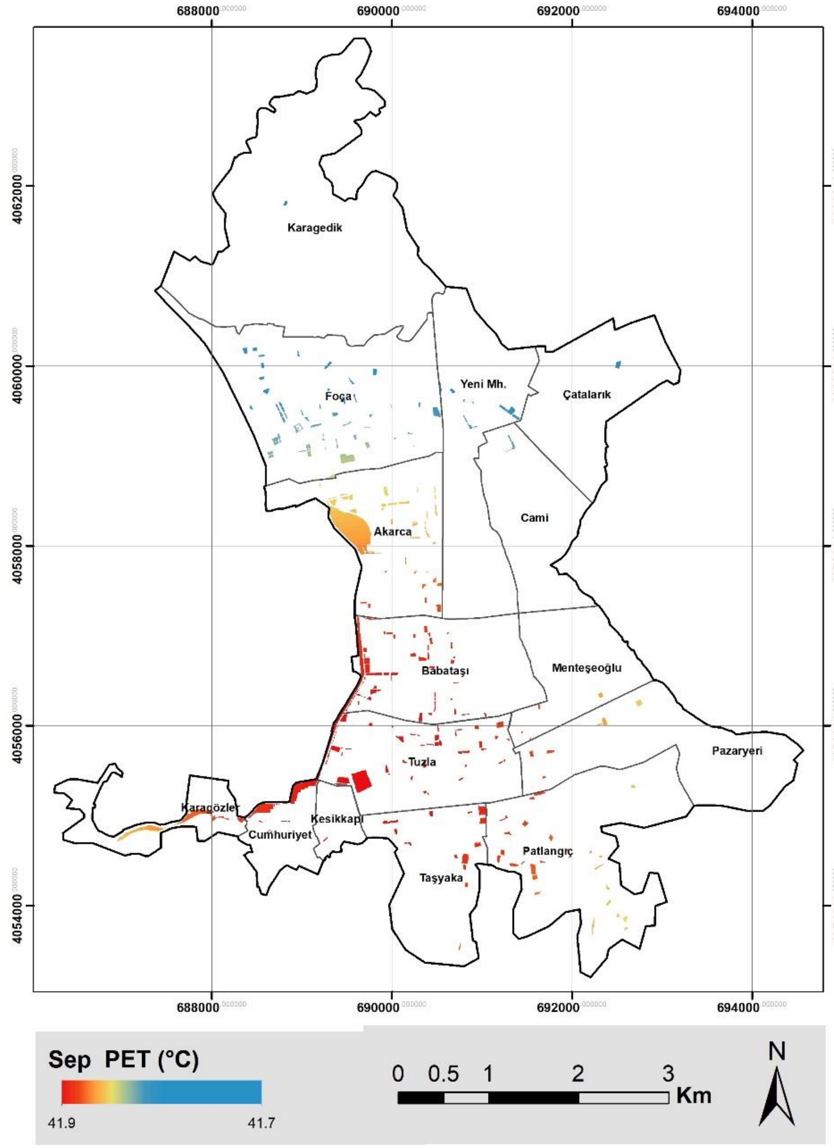


Figure 8. PET for the month of Sep

The PET values of the parks obtained for October are between 31.2 - 32.3 °C. At the parks in Fethiye city center, extreme heat stress is observed in October (Figure 9).

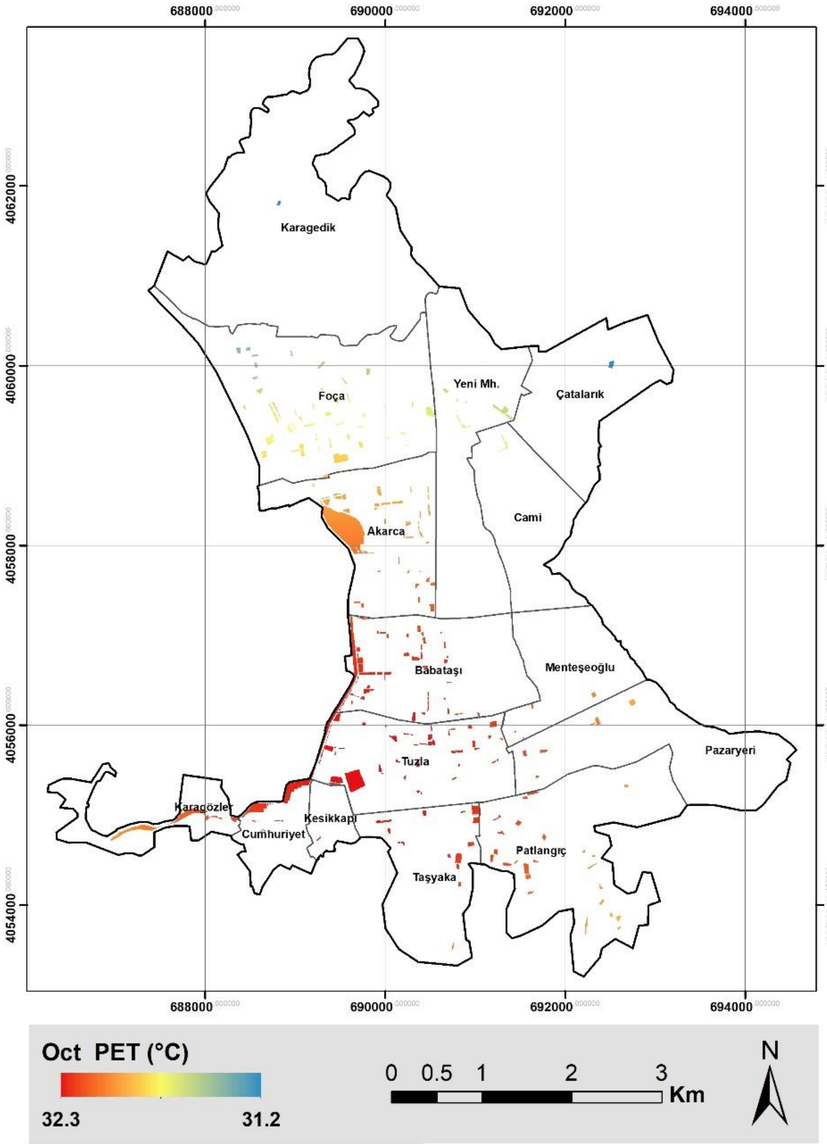


Figure 9. PET for the month of Oct

3. CONCLUSION

In this study, which was carried out to evaluate the bioclimatic comfort conditions of the parks and recreation areas in Fethiye city center between May and October months, it was concluded that the comfort conditions were partially deteriorated in May, June and October, and the comfort conditions were completely deteriorated in July, August and September months.

PET values were obtained between 28.9 - 29.7 °C in May in parks and recreation areas in Fethiye city center. Thus, it has been determined that there is mild and moderate heat stress and comfort conditions are partially deteriorated. PET values between 33.5 - 33.7 °C were obtained in June. These comfort conditions deteriorated a little more than May and it was found that there was moderate temperature stress. PET values between 41.7 - 42.4 °C in July, PET values between 41.5 - 42.4 °C in August and PET values between 41.7 - 41.9 °C in September were obtained. Thus, it has been determined that the comfort conditions are completely deteriorated and that there is excessive heat stress. In October, PET values between 31.2 - 32.3 °C were obtained and it was determined that the comfort conditions were partially deteriorated and moderate stress was found. The difference between the parks with the highest and lowest temperatures occurs most in October, and at least in June and September. When the parks were evaluated on a neighbourhood scale, it was determined that the highest PET value was in Tuzla neighbourhood and the lowest PET value was in Karagedik neighbourhood from May to October.

In future studies, obtaining data by establishing a meteorology observation station in parks and recreation areas will provide more precise results specific to parks or recreation areas.

Acknowledgments: The authors thank Fethiye Municipality and MGM for providing data.

REFERENCES

Acar, C. and Sarı, D. (2005). Kentsel Biyoçeşitlilik ve Peyzaj Planlama. 1.Çevre ve Ormancılık Şurası. http://sura.cevreorman.gov.tr.

Ardahanlıoğlu Bozhüyük, Z. R. and Karakuş, N. (2016). Determining the Recreational Potentials of Some of the Bays in Fethiye. Environmental Sustainability and Landscape Management. (Ed: Efe, R., Cürebal, İ., Gad, A. and Tóth, B.) ST. Kliment Ohridski University Press, pp.573-584, Sofia. ISBN:978-954-07-4140-6.

Ardahanlıoğlu Bozhüyük, Z. R., Karakuş, N., Selim, S. and Çınar, İ. (2018). Effects of Urban Developments on Agricultural Soils: Case Study of Fethiye/TURKEY. Recent Researches in Science and Landscape Management. (Ed: Efe, R., Zincirkıran, M. and Cürebal, İ.) Cambridge Scholars Publishing, pp.384-399, UK.

Arghavani, S., Malakooti, H. and Bidokhti, A.A.A.A. (2020). Numerical assessment of the urban green space scenarios on urban heat island and thermal comfort level in Tehran Metropolis. *Journal of Cleaner Production*, 121183.

Bolund, P. and Hunhammar, S. (1999). Ecosystem Services in Urban Areas. Ecological Economics, 29(2): 293-301.

Bowler, D. E., Buyung-Ali, L., Knight, T. M. and Pullin, A. S. (2010). Urban Greening to Cool Towns and Cities: A Systematic Review of The Empirical Evidence. Landscape Andurban Planning, 97(3): 147-155.

Cohen, P., Potchter, O. and Matzarakis, A. (2012). Daily and Seasonal Climatic Conditions of Green Urban Open Spaces in The Mediterranean Climate and Their Impact on Human Comfort. Building and Environment, 51, 285-295.

Çınar, İ., Ardahanlıoğlu, Z. B., Karakuş, N. and Yazar, K. (2017). Sürdürülebilir Turizm Faaliyetleri Kapsamında İklim Konforu Değerlendirmesi: Kıyı Akdeniz Yerleşimi, Fethiye Örneği. Fen, Matematik, Mühendislik ve Doğa Bilimleri Araştırmaları 2017. (Ed: Çiftçi, N., Kara, Y., Yalçınkaya, İ., Şahin, M. and Ağaçayak, T.), Çizgi Kitabevi Yayınları, ss. 235-241.

Çınar, İ., Çiçek, İ., Karakus, N. and Ardahanlioglu, Z. R. (2016). Thermal Comfort Assessment of the Urban Mediterranean Climate in Fethiye, Southwest Anatolia, Turkey". *International Journal of Advances in Science*, Engineeringand Technology (IJASEAT), 4(3): 46-51.

Çınar İ., Karakuş N. and Ardahanlioğlu Z. R. (2019). Biyoklimatik Konfora Sahip Alanların Belirmesi: Dalaman Örneği. V. Science Technology and Innovation Congress, Antalya, Türkiye, pp.444-448.

Çınar, İ., Karakuş, N., Ardahanlıoğlu, Z. R. and Selim, S. (2015). Evaluation of the Open and Green Spaces in the Aspect of Urban Ecosystems: Case of Fethiye City, Turkey. Environment and Ecology at the Beginning of 21st Century. (Ed: Efe, R., Bizzarri, C., Cürebal, İ., and Nyusupova, G.N.) ST. Kliment Ohridski University Press, pp.398-410, Sofia.

Emür, S. H. and Onsekiz, D. (2007). Kentsel Yaşam Kalitesi Bileşenleri Arasında Açık ve Yeşil Alanların Önemi-Kayseri/Kocasinan İlçesi Park Alanları Analizi. *Sosyal Bilimler Enstitüsü Dergisi* 22(1): 367-396.

Gül, A. and Küçük, V. (2001). Kentsel Açık-Yeşil Alanlar ve Isparta Kenti Örneğinde İrdelenmesi. *Türkiye Ormancılık Dergisi*, 2(1), 27-48.

Fethiye Ticaret ve Sanayi Odası, (2012). 2012 Fethiye Sosyo-ekonomik Rapor. Asude Ofset Matbaacılık, Fethiye.

Hami, A., Abdi, B., Zarehaghi, D. and Maulan, S. B. (2019). Assessing The Thermal Comfort Effects of Green Spaces: A Systematic Review of Methods, Parameters, and Plants' Attributes. Sustainable Cities and Society, 49, 101634.

Jamei, E., Rajagopalan, P., Seyedmahmoudian, M. and Jamei, Y. (2016). Review on The Impact of Urban Geometry and Pedestrian Level Greening on Outdoor Thermal Comfort. Renewable and Sustainable Energy Reviews, 54, 1002-1017.

Karakuş, N. (2010). Yutak Alanların İklim Değişikliği Üzerine Etkilerinin Türkiye Örneğinde Araştırılması. Yüksek Lisans Tezi, Çukurova Üniversitesi, Fen Bilimleri Enstitüsü, Adana.

Karakuş, N. (2016). Belediyelerin Rekreasyon Faaliyetlerindeki Rolü. Yerel Yönetimler ve Turizm Çalıştayı, 24-26 Mart 2016, Konya.

Karakuş, N., Selim, S., Ardahanlıoğlu, Z. B., Çınar, İ. and Özer, Ö. (2014). Aktif Rekreasyon Alanları Dağılımının Cbs Teknikleri ile Analizi Üzerine Fethiye Kent Merkezi Örneğinde Bir Araştırma. Türkiye Coğrafyacılar Derneği Uluslararası Kongresi, 4-6 Haziran, Muğla, ss.570-576.

Karakuş, N. and Yücel, M. (2011). Yutak Alanların İklim Değişikliği Üzerine Etkilerinin Türkiye Örneğinde Araştırılması. *Ç.Ü. Fen ve Mühendislik Bilimleri Dergisi,* 25(6): 125-134.

Kestane, Ö. and Ülgen, K. (2013). İzmir İli İçin Biyoklimatik Konfor Bölgelerinin Belirlenmesi. *SDÜ Teknik Bilimler Dergisi*. 3(5): 18-25.

Libanda, E., Nkolola, N. B. and Chilekana, N. (2020). Human Thermal Comfort and Urban Climate of Zambia's Economic and Political Hub: A RayMan Model Study. Modeling Earth Systems and Environment, 6(3): 1671-1682.

Mansuroğlu, S., Ortaçeşme, V. and Karagüzel, O. (2005). A Research on The Mapping of Ecologically Important Biotopes in Antalya City. International Congress on Information Technology in Agriculture, Food and Environment-ITAFE'05 (12-14 October), s.161-168, Adana.

Matzarakis, A., Mayer, H. and Iziomon, M. G. (1999). Application of Universal Thermal Index: Physiological Equivalent Temperature, Int J. Biometeorol, 43: 76-84.

Olgyay, V. (1973). Design with Climate, Bioclimatic Approach to Architectural Regionalism, Princeton University Press, 190 p., Princeton.

Özdamar, U. (2006). Açık-Yeşil Alan Kullanımlarının İmar Planlarındaki Dağılımları ve Uygulama Sorunları-Bursa Osmangazi Örneği. Yüksek Lisans Tezi, Dokuz Eylül Üniversitesi Fen Bilimleri Enstitüsü, İzmir.

Özer, Ö. Avcı, M. and Karakuş, N. (2013). An Evaluation of Alternative Tourism Opportunities in the Turkish Destination of Fethiye. Athens: ATINER'S Conference Paper Series, No: TOU2013-0637. Atina, Yunanistan.

Özer, Ö., Avcı, M. and Karakuş, N. (2016). A Study For the Evaluation of Alternative Tourism Opportunities in Fethiye Destination. *Journal of Tourism and Gastronomy Studies,* 4(1): 21-26.

Özer, Ö. and Karakuş, N. (2012). Dalyan Destinasyonundaki Rekreasyonel Olanakların Değerlendirilmesi ve Rekreasyonel Potansiyelin Araştırılması. I. Rekreasyon Araştırmaları Kongresi, 12-15 Nisan, Antalya, ss. 574-586.

Öztan, Y. (1968). Ankara Kenti ve Çevresi Yeşil Alan Saha Sisteminin Peyzaj Mimarisi Prensipleri Yönünden Etüd ve Tayini, A.Ü. Ziraat Fakültesi Yayınları no: 344, Ankara.

Rudel, E., Matzarakis, A. and Koch, E. (2007). Summer Tourism in Austria and Climate Change. In: Oxley, L. and Kulasiri, D. (eds) MODSIM 2007 International Congress on Modelling and Simulation. Modelling and Simulation Society of Australia and New Zealand, December 2007, pp. 1934-1939.

Selim, S. and Karakuş, N. (2016). Sufficiency of Public Open-Green Spaces in Fethiye Town/Turkey and Accessibility Analysis with GIS Techniques". I. Uluslararası Akademik Araştırmalar Kongresi Bildiriler Kitabı (INES 2016), Antalya, Türkiye, 3-5 Kasım 2016, vol.1, ss.82-87.

Selim, S., Karakuş N., Ardahanlıoğlu, Z. B. and Zengin, M. (2014). Fethiye Kenti Açık ve Yeşil Alan Dağılımlarının Cbs Teknikleri ile Analizi. Türkiye Coğrafyacılar Derneği Uluslararası Kongresi, 4-6 Haziran, Muğla, ss. 577-585.

Thorsson, S., Honjo, T., Lindberg, F., Eliasson, I. and Lim, E. M. (2007). Thermal Comfort and Outdoor Activity in Japanese Urban Public Places. Environment and Behavior, 39(5): 660-684.

Topay, M. (2012). Importance of Thermal Comfort in the Sustainable Landscape Planning, *Journal of Environmental Protection and Ecology*, 13(3):1480–1487.

Topay, M. (2013). Mapping of Thermal Comfort for Outdoor Recreation Planning Using GIS: The Case of Isparta Province (Turkey). *Turkish Journal of Agriculture and Forestry*, 37,110-120.

Toy, S. and Yılmaz, S. (2008). Peyzaj Tasarımında Biyoklimatik Konfor ve Yaşam Mekanları İçin Önemi. *Atatürk Üniversitesi Ziraat Fakültesi Dergisi*, 40(1): 133-139.

Üstündağ, Ö., Devecioğlu, S. and Akarsu, E. E. (2011). Elazığ Şehir Merkezinde Spor ve Rekreasyon Alanları Dağılımlarının Coğrafi Bilgi Sistemleri Metodu ile Analizi. 6th International Advanced Technologies Symposium (IATS'11), 16-18 May 2011, Elazığ.

Yang, Y., Zhou, D., Wang, Y., Ma, D., Chen, W., Xu, D. and Zhu, Z. (2019). Economical and Outdoor Thermal Comfort Analysis of Greening in Multistory Residential Areas in Xi'an. Sustainable Cities and Society, 51, 101730.

Yücekaya, M. and Uslu, C. (2020). An analytical model proposal to design urban open spaces in balance with climate: A case study of Gaziantep. Land Use Policy, 95, 104564.

Yücel, M., Karakuş, N. and Çolakkadıoğlu, D. (2009). İklim Değişikliği ile Yutak Alanlar Arasındaki İlişkinin Türkiye Ormanları Örneğinde Araştırılması. 1. Ulusal Kuraklık ve Çölleşme Sempozyumu, 16-18 Haziran, ss. 807-815, Konya.

Zoulia, I., Santamouris, M. and Dimoudi, A. (2009). Monitoring the Effect of Urban Green Areas on The Heat Island in Athens. Environmental Monitoring and Assessment,156(1-4): 275- 292.

CHAPTER 13

EXIGENCE OF GREEN SPACE DESIGN IN CONSERVATION DEVELOPMENT PLAN: TOKAT URBAN PROTECTED AREA

Assist Prof. Dr. Mustafa ERGEN *

* Siirt University, Faculty of Fine Arts and Design, Department of Architecture, Siirt, Turkey. E-mail: mustafaergen2002@yahoo.com ORCID ID: 0000-0001-8320-9130

INTRODUCTION

City forms a substantial criterion as it reflects cultural lifestyles of housing within living dynamics and connects the past and future. Within the framework of urban space concept, buildings are priorities of communities and indispensable for life factor. Streets, squares and open spaces that encircle buildings draw attention as spaces for public use.

İnceoğlu and Aytuğ (2009), in their study, define the urban space as the relationship of the outer space buildings with each other and other factors around them. This definition brings to light that factors outside buildings form space and makes ground within the living mechanism of the space. It is obvious that urban space has a meaning with its environment and becomes a part of the community.

Rob Krier (1979) defines urban space as settlements that have spatial characteristics in line with the city or structured by space (İnceoğlu and Aytuğ, 2009). That is, space is meaningful with its environment. Space that can be explained as the center for cultural change and interaction and urban spaces bearing the traces of the past and cultural interaction acquire substantial dimension as they reflect the community and sustain the space.

This dimension is an important factor of urban space and public space, and reveals a healthier urbanization approach by adding meaning to cultural infrastructure of urban development. Protection of the link between the past and present by urban spaces that connects the past and present where cultural interaction springs with the emergence of interaction between public spaces and cultures depends on the protection of the space from all aspects.

Gökgür (2008) defines public space as a space where social and spatial forms come across. Gökgür (2008) who defines landscaping as a spatial form tries to set forth the expression that it is a part of public space with green spaces. Cultural life forms a structure that includes both the residential areas and the green elements around the housing zone. Green spaces that are a substantial part of urban spaces in this sense have been of vital importance from past to present. People's approaches to natural life depending on the use of green spaces guide us in terms of understanding the life cultures in the urban area.

Urban green spaces were ignored during rapid development of urban spaces, which has caused to pay more attention to increase measures for the recovery of green spaces as a result of inconsiderate regulations. Many approaches and planning criteria such as access to green spaces and the amount of green spaces per individual have been brought into agenda. Among the urban protected areas, where the sociological and cultural lifestyle of the city are protected, the cityscape should also be maintained as an element of lifestyle, and should be protected and brought to the present, just like buildings.

As the urban protected areas are generally designed to protect cultural and historical structure and texture, it is targeted to (Ergen, Güçer, Özgür, 1994);

-Integrate the whole urban protected areas,

-Create protected regions in the urban and historical protected areas and make a dynamic plan through package projects in the region,

-Eliminate the hole plan application in planning.

In this regard, the open green space balance which is an exigence of planning in the historical protected areas should be retained (Ergen, Güçer, Özgür, 1994).

Considering that urban green spaces increase habitability in the city and make the spaces more usable, it is necessary to protect and use in a balanced way the green spaces that are inherited from the past.

This study analyzes the approach to create green space based on open area in the development plan studies, which are prepared using two different development plan techniques of the city formed by the urbanization in and around the urban protected areas.

In this sense, it is necessary to make decisions about both housing areas regarding conservation development plans and regarding green spaces. This study will put forward the requirements for examining the condition of green spaces within conservation practices in Tokat urban protected area and the necessity and protection of green spaces.

1. MATERIAL AND METHOD

Tokat is a province at the Central Black Sea region of Turkey. Tokat, which has borders with Samsun, Amasya, Sivas and Yozgat provinces, has a surface of 998,442 km2 (ÇED and Çevre İzinleri Şube Müdürlüğü, 2020) (Figure 1). Since Tokat has an important cultural structure from the past to the present, the development of urban protected areas is carried out through the development plans intended for protection from the past to the present.

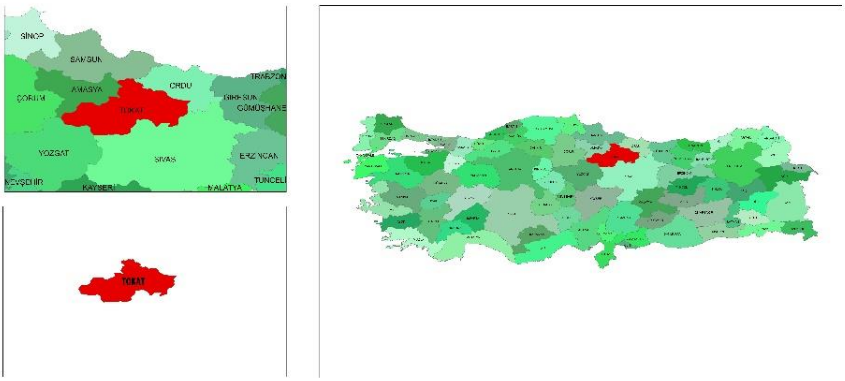


Figure 1. The Location of Study Areas

Historical background of architectural structuring in the urban area of Tokat dates back to the year 900 and the architectural structures of the Seljukian and Ottoman periods keep their existence (Acar et al., 2015). Thus, Tokat province is an important city in terms of applying protective approaches. The Conservation Framework Development Plan in Tokat (Tokat Kentsel Sit Alanı Analitik Etüdleri ve Koruma İmar Planı Çerçeve Plan Raporu, 1992), chosen as the area for this study, will also shed light on the green space approaches of other areas in Turkey and enable review of the practices, as it also sheds light on other urban protected areas. In this sense, Tokat sets forth a sampling approach that may guide other urban protected areas.

Therefore, the data obtained on the pertinence and protection of the current situation of the urban green spaces around the protected area within the development of the city to the conservation plans for protection enlightens us.

Development plans at a scale of 1/5000 obtained from the municipality were converted from Netcad data into ArcGIS and the necessary analyzes were made. Geographical information system shows not only detection of protected areas but also distribution of green spaces in the planned natural areas, besides showing the type of urban development in Tokat.

Tokat development plan determines the development of the protected area and its surroundings with a decision of planning and how the use of public space is ensured. With this determination, the situation of urban green spaces in the conservation plans will be better understood and the planning approach of green spaces for protected areas will be clear.

Parks, areas to be afforested and forests in the Tokat development plan are defined as green spaces. Therefore, how natural and unnatural green spaces will be structured around and within the protected areas is shown. Furthermore, housing zones and the proposed housing zones are named as residential areas, and the type of housing development around the protection areas has been analyzed. Also, the area where the conservation development plan was implemented has been determined and the type of land use around this area has been determined.

The most important decision taken in the Conservation Framework Development Plan in Tokat is that the planned area of the city is to reduce the application up to a scale of 1/1 with the package projects. These projects are grouped as (Ergen, 1993);

-Projects of Public Area,
-Projects of Open Area,
-Public Projects,
-Conservation Directive Projects,

including a project of open area (Ergen, 1993). The projects of open area have been developed as a new method for a more effective application regarding green space.

As a result of the conservation framework development plan, whether green spaces will be considered within the emphasis on public spaces will be set forth. We will share the results of our findings on the necessity of considering green spaces in conservation area planning and provide solutions.

2. RESULTS

The data obtained in Tokat province indicated how the land use planning, which emerged from the conservation development plan was shaped. It is known that the regulation on the conservation development plans and the procedures and principles for preparation, demonstration, application, inspection of the landscaping projects and the authors underlined the implementation fundamentals for regulation of the area which was decided to be protected. Considering that the urban space is not limited to buildings only, it would be appropriate to underline the necessity of protecting its environment instead of landscaping.

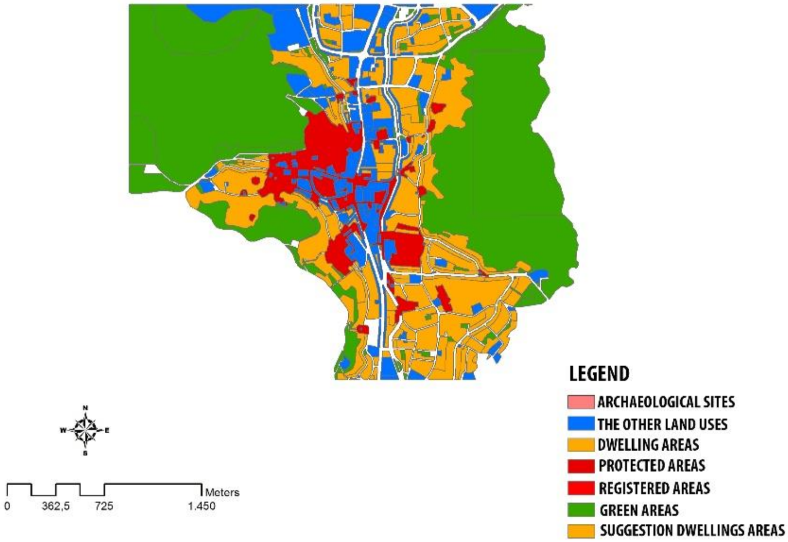


Figure 2. Distribution of Protected Areas and Green Areas in Tokat Development Plan

Considering the map (Figure 2) shown by the data obtained from the Tokat Development Plan, the areas in red step forth as protection areas. The housing zones shown in yellow and the proposed housing zones are planned in an integration with the protected area. This shows the exigence of making a balance between the new housing zones and the modern buildings with conservation value. It is necessary to use green spaces as intermediate elements and to make spatial transitions into modern buildings and to conserve historical buildings.

It is remarkable that the green spaces shown in green color are formed outside the protected areas. Considering the fact that green spaces protect urban space historically and culturally, it is evident that the protection remains on the basis of buildings only and the real identity of the space cannot be conserved. All kinds of space elements used in public should be protected to literally conserve the cultural values of the space.

3. CONCLUSION

With the application of the development plan for protection, the Tokat urban protected area reveals that green spaces are not considered as urban space elements. Green spaces have an important place among the public spaces where there is cultural unity of the urban space.

Although the regulation on the conservation development plans and the procedures and principles for preparation, demonstration, application, inspection of the landscaping projects and the authors underlined the green space in the urban protected area definition, it seems that protection works have not been carried out with the integration of green spaces with the protected areas.

As green spaces are a part of the culture in the urban space, increasing the practices for protection of green spaces will make conservation plans to be more successful and ensure conservation of the living culture of the city also.

To yield more effective results in the protected areas, the following measures can be taken;

a. The protected areas should be considered as a whole (street, green space and building).
b. Cultural and historical values should be conserved in all aspects.
c. Conservation should be considered by experiencing the atmosphere and sustaining it, since a conservation decision includes protecting a lifestyle.
d. There should be a balance of open and green space in the protected areas and outside urban areas; and the quality of life in the urban protected areas should be promoted.
e. It is necessary to make an integration within the architectural structure by creating transition zones between the protected areas and other areas of development.

Consequently, protection should not focus on the building only, but should be considered within a spatial theory. Since many protection works focus on buildings, the outcomes cannot be at the desired level and the area to be protected disappears eventually. Furthermore, conservation should sustain the previous culture since an area gains value with the culture of those living in it and so maintains its presence.

Acknowledgement: The author is responsible landscape architecture issue of the parcel numbers of 59, 132, and 391 for conservation plan. The author appreciates to Tokat Municipality for accessing data and information.

REFERENCES

Acar, İ., Erdoğan S., Gedikli, A., Açıkel, A., Eroğlu, İ., Yılmaz, F., Kalaycı, M., Türk, T., Gebeş, N., N., Namlı, Y., M., Sezer, O., Ateş, E., Emekli, E. (2015). Tokat Şehir Kimliği Çalıştayı Sonuç Raporu, T.C. Çevre ve Şehircilik Bakanlığı

ÇED ve Çevre İzinleri Şube Müdürlüğü. (2020). Tokat İli 2019 Yılı Çevre Durum Raporu, Türkiye Cumhuriyeti Tokat Valiliği Çevre Ve Şehircilik İl Müdürlüğü.https://webdosya.csb.gov.tr/db/ced/icerikler/tokat_2019_cevre_durum_raporu_son-20200827123628.pdf Accessed Date: 07.04.2021

Ergen, Y.B. (1992). Tokat Kentsel Sit Alanı Analitik Etüdleri ve Koruma İmar Planı Çerçeve Plan Raporu. Gazi Üniversitesi Döner Sermaye İşletmesi Baskısı, ANKARA, Sa:44-45, (B.30.2.Gün.047.00.01-29/127- 25.09.1992 – 11088 Kayıtlı KKTV Kurul onayı)

Ergen, Y.B., Güçer, B., Özgür, M. (1994). Kentsel Sit Alanlarında Kentsel Gelişmeden Olumsuz Etkilenmesi ve Yöntem Araştırması. 2. Kentsel Koruma Yenileme ve Uygulamalar Kolokyumu, Mimar Sinan Üniversitesi, Mimarlık Fakültesi, Şehir ve Bölge Planlama Bölümü Yayını, İSTANBUL 1994, Sa:90

Ergen, Y.B. (1993). Koruma Planlamasında Paket Projelerle Uygulamanın Güncelleştirilmesinde Tokat İli Örneği. Ulusal Koruma Planlaması Semineri II. ICOMOS Türkiye Milli Komitesi Yıldız Teknik Üniversitesi, İSTANBUL, Sa: 218

Gökgür, P. (2008). Kentsel Mekanda Kamusal Alanın Yeri, Bağlam Yayınları 295, İnceleme-Araştırma 204, ISBN: 978-975-8803-88-0. İstanbul, Sa: 22

İnceoğlu, M., Aytuğ, A. (2009). Kentsekl Mekanda Kalite Kavramı. *Megaron Dergisi*, Cilt 4, Sayı 3 ISSN: 1305-5798 / 1309-6915, İstanbul, Sa: 131-146

Krier. R. (1979). Urban Space, New York, Rizzoli

CHAPTER 14

SPATIAL PLANNING, LANDSCAPE AND CLIMATE JUSTICE IN TURKEY

Assist. Prof. Dr. Merve ERSOY MİRİCİ *

* Bursa Technical University, Faculty of Forestry, Department of Landscape Architecture, Bursa, Turkey. E-mail: merve.mirici@btu.edu.tr ORCID ID: 0000-0002-8610-6169

INTRODUCTION

The economy, development targets, industrialisation, the need for food and space, urbanisation, global climate change, environmental problems and local solutions are in a state of constant interaction with one another. It is possible to observe the reflections of economic targets in a spatial sense. Therefore, the system of thought builds the space and the spatial processes are transformed first into physical reality and then into a psychological living space assimilated by society. In terms of living space, approximately 60% of the world's population lives in cities. At the same time, this space is one of the actors in climate change, since in line with economic targets, industrialised areas located within and on the periphery of cities, and emissions stemming from transport are the most important factors increasing anthropogenic global warming. However, green sinks that will compensate for greenhouse gas emissions within urban systems are ignored. One of the wide range of ecosystem services provided for the benefit of humans especially by natural and cultural landscapes is carbon storage and sequestration. Therefore, landscape and ecosystem services are located at the intersection of spatial planning and global climate.

In this study, the current spatial planning hierarchy in Turkey is presented within the framework of space, planning and spatial planning. The position of green spaces, which must serve as carbon sinks in urban systems that are witnessing global climate change, in the spatial planning system is revealed within the planning hierarchy. Accordingly, it is inevitable that a more effective landscape planning discipline in spatial planning strategies will make a positive contribution to global climate change and climate justice paradigms. In this context, in the study, landscape planning, the economy, the driving forces in global climate change, and the paradigm of intergenerational justice are investigated, and recommendations are made.

1. SPACE AND SPATIAL PLANNING

The concept of space is unclear, paradoxical, frequently inconsistent and rich. There is as yet no single and conclusive clear definition of space. According to Aristotle, space enables the naming and classification of tangible phenomena. Mathematicians believe that space is dimensional. In Leonardo da Vinci's view, however, space is an intellectual phenomenon. It is the exploration of the theoretical unity between separately located areas such as electromagnetic and gravitational forces in physics. According to Kant, while it is regarded as the way tangible phenomena are arranged, it is mostly regarded as undefined empty surroundings (Lefebvre 2016). In Newton's view, it is an absolute part of space independent of its content, whereas in the opinion of Leibniz, it is the arrangement formed from the connections between the objects inside it. Space is not an entity/substance, it is a correlation. The connections that the positions of entities form between each other disappear by creating a whole, and a space is formed. Current science also embraces the concept of space not as an entity, but as the whole of relationships (Usta 2020). If space is an object, the human is a subject and everything that surrounds the subject constitutes space. If there is an individual who is the subject of space and if human perceives the space and feels surrounded, then space can be referred to (Schmarsow and Fiedler 2017). Therefore, when an individual is surrounded by inanimate (architecture) and animate (landscape) components, these are objects that physically form the perception of space. The city is an urban space and exists in the association of town planning and landscaping. As for the ground, which is a wider spatial plane, this depends on the scope of authority of planners and economists (Lefebvre 2016). The concept of space includes not only structures but also natural and cultural physical environments. In this context, the concept of architecture should be perceived not merely as constructive art, but also as a planning and design organisation for the future of the physical environment or every kind of natural and cultural area. The duty of the architects, town planners and landscape architects who create space is to conscientiously satisfy people's spiritual hunger and material needs. In the process of meeting individual and societal needs, planning is used as an indispensable tool.

Planning is a process which enables the establishment of the most appropriate intellectual assimilation of the future within the framework of the basic limiting data of a social system, and which, in the case of problems encountered in the implementation of this assimilation, also enables the established model to be reimposed and modified. The primary objective and determination of policies, the investigation of options applicable for this objective and these policies, and among these, the determination of the one most compatible with previously specified principles constitute the institutional aspect of this process

(Ersoy, 2016). In the European Regional/Spatial Planning Charter, spatial planning is defined as the physical organisation of an area according to a policy and general strategy for the economic, social, cultural and ecological policies of society, and for disciplined and balanced regional development (European Commission, 1997). The aim of spatial planning is to enable the development of society by making the physical arrangements that are desired to be achieved for the future by taking the natural and cultural environment into consideration. Spatial planning includes regional planning, transport and the environment and encourages the economic growth of a region including both urban and rural areas. Spatial planning is carried out at local, regional and national levels. In this context, spatial planning is discussed with a broader and more comprehensive approach than traditional land use planning. Furthermore, by unifying and integrating policies for the development and use of land, it exhibits an approach that will influence development policies, and the needs of these policies, that affect the quality of places/spaces and the functioning of these (Kılınç 2018).

2. TURKEY AND THE HIERARCHY OF SPATIAL PLANNING

It can be stated that the spatial planning system in Turkey is basically divided into three defining periods. Accordingly, these are the first period of the Planning Law no. 6785 dating from the founding of the Republic until the year 1986 (1923-1985), the second period beginning with the acceptance of the Planning Law no. 3194 in 1985 (1985-2011), and while this law was in force, the third period beginning with the establishment of the Ministry of the Environment and Urbanisation in the year 2011 (Dede and Sekeroğlu 2020). The first period was one of foundation and quest. Indeed, after the First World War, the country was in an effort to be built. During this period, the Municipalities Bank was founded by Atatürk himself. Its main objective was to enable development and to create a fund for municipalities to carry out their reconstruction work. In 1945, besides the municipalities, villages and special provincial administrations were included in the institution's services and it was named the Iller Bank. In this period, there was a preoccupation with rapid urbanisation, and for this reason, the research and analysis processes prior to planning were generally ignored. In 1945, the authority to carry out spatial planning was transferred from the municipalities to the Iller Bank, while approval authority was transferred to the Former Ministry of Public Works and Settlement. It can be stated that since the disciplines of town planning and landscape architecture were not fully developed in Turkey between the years 1933-1960, planning were generally made by foreign experts and Turkish architects. During the years 1945-1980, almost all of the zoning plans produced in the country were made by the Iller Bank (Gezim and Kiper 2016). This period was one in which there was no aggressive urbanisation period and in which urbanisation was newly formed. The lack and inadequacy of green spaces was not seriously striking. The second period of spatial planning began with the conversion of the Planning Law no. 6785 into the Plannig Law no. 3194. The main change in this period was the transference of planning approval authority from the centre to local administrations. Gezim and Kiper (2016) stated that in this transfer of authority, the municipalities were caught unawares and that rather than decreasing, the workload of the Iller Bank increased. The third breakpoint related to spatial planning in Turkey was experienced with the radical changes in the year 2011. In this period, the Ministry of the Environment and Urbanisation was founded, the *Spatial Plans Formation Regulation* was prepared, and the Iller Bank, which had an active role in spatial planning processes, was removed from its status as a state institution and converted into the Ilbank Incorporated Company in 2011. As stated by Dede and Sekeroglu (2020), although the authority to make, procure and implement plans was in the hands of the local administrations, this physical planning process began to evolve in another direction together with the founding of the Ministry of the Environment and Urbanisation in 2011. The authority to determine and implement the basic principles, strategies and standards regarding land use in plans to be made in urban and rural areas belongs to the Ministry.

The town planning system in Turkey exhibits a holistic and top-down characteristic. In Turkey, the Planning Law no. 3194 has the nature of a basic law with regard to planning, and is the most comprehensive law related to making spatial plans in terms of procedures and principles, planning powers, and preparation, approval and implementation of plans (Planning Law, Offical Gazette, 18749 (09/05/1985), Law No. 3194). At the drafting and approval stage of zoning plans in Turkey, the basic law is the Planning Law no. 3194 (Dede and Sekeroğlu 2020). In Turkey, the planning hierarchy is basically discussed as i) socio-economic plans, ii) upper scale spatial plans, iii) sub scale spatial plans, iv) ad hoc plans, and v) complementary spatial plans. In order to achieve national reconstruction and development targets, the complement of economic plans are spatial plans. In Turkey, in descending order from large-scale to small-scale, the hierarchy was created as i) development plans, ii) regional plans, iii) strategic spatial plans, iv) province environmental order plans v) metropolitan plans, vi) environmental order plans (1/50 000 and 1/100 000), vii) master zoning plans (1/5 000 ve 1/25 000), and viii) implementary zoning plans (1/1 000, respectively (Dede and Şekeroğlu 2020). Provided that they are suitable and necessary, ad hoc plans consisting of conservation-oriented development plans, tourism-oriented development plans and special environment protection regional plans, in addition to complementary plans consisting of supplementary zoning plans, revision zoning plans and local zoning plans, make up the local spatial plans.

i) Socio-economic plans
   - Development plans
   - Regional plans

ii) Upper scale spatial plans
   - Strategic spatial plans
   - Metropolitan plans
   - Environmental order plans

iii) Sub scale (local) spatial plans
   - Master zoning plans
   - Implementary zoning plans

iv) Ad hoc plans (special purpose)

- Conservation-oriented development plans
- Tourism-oriented development plans
- Special environment protection regional plans

v) Complementary plans

- Additional zoning plans
- Revision zoning plans

Among the levels of planning, one of the prominent types of planning, particularly in recent years, is strategic spatial planning. In the creation of strategic spatial plans, the Integrated Urban Development Strategy and Action Plan (KENTGES) has been considerably effective. The main foundations of this were laid by the medium-term targets of the 9th Development Plan created by the State Planning Organisation. The main objectives of KENTGES are the reconstruction of the spatial planning system, increasing the spatial living quality of cities, and reinforcing the economic and social structure of settlements. With the documentation centre created as a result of the urbanisation council and with the participation of the local authorities, KENTGES is a guide for planning work and actions related to transport infrastructure, housing, disaster preparedness, conservation, climate change, life quality and social policies (KENTGES 2016).

The reconstruction of the spatial planning system gathered speed after the third breakpoint for spatial planning in Turkey in 2011. Within this scope, first of all, the reconstruction of the Ministry of Public Works and Settlement and the preparation of a spatial planning framework law for urbanisation were targeted. Accordingly, the relevant national socio-economic Development Plans were transferred from the State Planning Organisation first to the Ministry of Development and then to the Ministry of Industry and Technology's Strategy and Budget Department. In parallel with this, in 2011, strategic spatial planning was included in planning legislation for the first time, and the task of preparing strategic spatial plans was given to the Ministry of the Environment and Urbanisation in cooperation with the relevant institutions and organisations. The Strategic Spatial Plan is a plan which guides physical development and sectoral decisions by associating economic, social and environmental policies and strategies with space, and which is prepared in the country as a whole and from the regions considered necessary, complete with its report (MSP 2020). Strategic spatial planning was developed as a result of the inadequacy of the traditional comprehensive planning approach when faced with new phenomena and problems that emerged, especially in big cities, and due to the need that was felt for a more flexible approach for generating solutions to sudden and large changes.

3. THE PROBLEMATIC OF SPATIAL PLANNING AND LANDSCAPE

In the Spatial Plans Formation Regulation, which was enacted in 2014, it is stated that Strategic Spatial Plans are the highest level of spatial plans. Accordingly, the levels of planning are, in order of the highest to the lowest: Strategic Spatial Plans, Environmental Order Plans, Master Zoning Plans and Implementation Zoning Development Plans. Spatial plans are prepared in accordance with the plan grading. Pursuant to the principle of graded association between plans, every plan is required to conform to the decisions of the highest-level plans in operation, to form a whole with its report, and to direct the plan at the next level down. Among its principles are improvement of life quality, observance of spatial harmony, and strengthening of relationships between urban and rural areas.

There is a concern of Strategic Spatial Plans related to descending from the national scale to the local scale. Therefore, in analyses of the current situation and in the objectives desired to be achieved, the issues of creating more habitable settlements, optimisation of transport, sustainability in ecosystem services, and climate change have been focused on. Especially in the 10th Development Plan, it is observed that habitable spaces and sustainable environmental goals have come to the fore. These are the strengthening of the technical infrastructure and environmental management aimed at sustainable development, climate change, and the development of biological diversity strategies and action frameworks (MPGM 2020). However, it is striking that in these action plans and strategies, phenomena such as natural structure, lack of reinforcement areas, and climate change are not dealt with in integration with natural and cultural landscapes. Indeed, the relationship especially between ecosystem services and landscaping is ignored, and landscaping is discussed very limitedly and superficially in the Strategic Spatial Plan Scoping Report for Turkey. In parallel with this, not only are definitions of natural and cultural landscapes not included in the Spatial Plans Regulation, but also, they are defined only as green spaces, parks and recreation areas by reducing them to social reinforcement areas. In Clause 5 of the Spatial Plans Formation Regulation, it is stated that according to the definitions of spatial use, social infrastructure areas are the general name given to educational, healthcare, religious, cultural and administrative facilities, open and closed sports facilities, and open and green areas like parks, playgrounds and play areas constructed by the private and public sector with the aim of meeting the cultural, social and recreational needs of individuals and society and increasing their quality of life within a healthy environment.

It can be stated that in the spatial planning approach for Turkey, a definite strategy aimed at building the relationship between humans and nature does not exist. Accordingly, the fact that landscape has the feature only of parks distributed around cities has reduced it to the level of spatial use for social reinforcement. In many developing countries like Turkey and in undeveloped countries, cultural landscapes have the characteristic only of parks. However, within the scope of building green space strategies in urban systems, enabling ecological connectedness, increasing the capacities of ecosystem services and climate change reduction policies, natural and cultural landscapes act as a serious carbon sink.

4. GLOBAL CLIMATE CHANGE AND ITS INTERACTION WITH SPATIAL PLANNING

For humans to be able to carry out their vital functions, the needs that they have to meet are continuous and endless. One of these vital functions is the need for space. Therefore, humans are in a state of constantly transforming nature and the ecosystem in line with their needs. It is possible to state that humans definitely benefit through the medium of ecosystem goods and services. The economic structure, in which the ecosystem is used as capital without paying a fee, is the most important factor serving nations' continual desire for growth. Especially after the industrialisation era, the destruction of natural capital and the increase in greenhouse gas emissions resulting from human activities like industrialisation and urbanisation are the biggest agents of global warming (IPCC 2014), since due to emissions, the disruption of the radiative equilibrium underlying global climate change is encountered. In other words, the main reason for climate change is the change in the radiative equilibrium undergone on the planet. The radiative equilibrium is between the short-wave solar energy entering the atmospheric system from the sun and the long-wave energy reflected from the earth's surface. When the ecosystem is in balance under normal conditions, the atmospheric layer is less permeable to short-wave solar energy. However, the thinning of the atmospheric layer and anthropogenic emissions harboured by aerosols increase the greenhouse effect by remaining suspended between the earth's surface and atmosphere. The agent that changes this balance between the radiation reaching the earth from the sun and reflected from the earth's surface layer also has an impact on the climate system. This change in the radiative equilibrium can create not only a warming but also a cooling effect. The increase in the rate of greenhouse gases in the atmosphere with the anthropogenic effect leads to the formation of positive radiative forcing which creates a warming trend. The positive contribution made by the common earth-atmosphere system to the energy balance is known as the enhanced greenhouse effect. The increase in mean temperatures experienced with this effect is global warming (REC 2015).

The increase in greenhouse gas accumulations in the atmosphere due to human activities, or global warming, triggers a series of chain reactions. Anthropogenic activities carried out at a national or regional level are reflected at a global level. The increase in mean global temperatures results mainly in rainfall irregularities, a reduction in agricultural productivity, a decrease in bioclimatic comfort in urban systems, and an increase in the effect of the urban heat island; and these changes are again cyclically reflected through this irregularity on socio-economic situations by affecting the existence and distribution of natural resources. Within this framework, the prominent measures aimed at minimising the potential effects of climate change are "reduction" and "adaptation". The reduction framework aimed at global climate change focuses on the economic dimension that involves national sanctions, while the adaptation framework focuses on local specific urban implementations.

It can be said that there are predominantly two main driving forces in global climate change, namely economic growth concerns, and fossil fuels and land cover change due to industrialisation/transport. If it is observed that industrialisation occurs in urban areas, it will not be wrong to say that cities are the main location of global climate change. Within urban systems, building stocks and transport; while on the periphery of cities, industrial and agricultural areas, create sources of anthropogenic emissions. Therefore, the spaces that will witness reduction and adaptation policies against global climate change are the cities. Both for making cities resistant to climate change and for supporting reduction policies, the functionalisation of landscape components that enable concurrence between humans and nature is of great importance. Urban components such as the macro-form of the city, building typologies and plant cover systems play an important role in the formation of the urban climate with their capacities to create atmospheric change (Peker and Aydın 2019; Smith 2005). Especially, a city form and structural arrangement for low-carbon cities, the optimisation of urban transport, the creation of a green infrastructure and a landscape concept that will increase ecosystem service capacity, the management of water resources, and an increase in public awareness and technological capacity are required. The cultural landscape areas located within city systems are a provider of ecosystem services, and must be used with their green infrastructure component as an interface in establishing the relationship between nature and the city. The use of green space systems as an effective reduction strategy is directly correlated with the green space system that is designed. Details such as plant species that absorb carbon, planting in accordance with local climate conditions, and a per-hectare urban density-green space ratio are important for carrying out green strategies effectively.

5. CLIMATE JUSTICE

Global climate change has many components such as countries' economic power, population, and technology and energy use. Therefore, it retains its uncertainty and stochastic structure (Ersoy Mirici 2017). The rapid increase in population and the ability to meet basic needs like food and shelter has led to competition among countries and therefore to an aggressive growth in the economy. Economic competition between countries has become one of the main conditions for a powerful state. It can be said that globally, since the increasing dynamics encountered ranging from the individual to society form a complex and complicated structure, the ecosystem has been damaged at a serious rate. In the damage to the ecosystem, the errors made in urbanisation and spatial planning are reaching an irreversible dimension. The natural landscape areas that were a part of the ecosystem in the past have been transformed nowadays into living spaces that have assumed a predominantly urban identity. While this transformation has caused negative feedback on current social psychology, the main concern for future generations is about facing great environmental crises, since while current society is dissatisfied with the cities it lives in and is faced with global warming, future generations will be born into a changed climate and will inherit the current climate problem from us. Therefore, in the current projection, the development of the correct adaptation and reduction strategies and the development of natural landscape areas as green infrastructure that establishes the ecological link with nature within city typologies is the leading measure that can be made spatially.

According to John Locke, people living in society have three basic natural rights (Tuckness 2018). These are the right to life, the right to property, and the right to freedom. Wherever there is something that develops with regard to socialisation and society, the struggle for rights and justice also continues to exist. The root of climate justice is environmental justice. While environmental justice involves problems on a local level, climate justice is the point reached by local problems in a global dimension. Climate justice is an important concept that goes beyond treating climate change as merely a change occurring in environmental or natural conditions, and deals with climate change as an ethical and political issue and creates opportunities for debate. It associates the effects of climate change with the concepts of justice, and especially of environmental and social justice. It realises this by discussing the issues of equality, human rights, collective rights, and the historical responsibility for and ecological debt of climate change. The most basic premise of climate justice can be expressed as the fact that those who are least responsible for climate change are exposed the most and the most seriously to its effects (Dogru and Alica 2019).

In terms of natural capital, the most important processes in the economic system and ecological system occur with transfers between flows and stocks. In this context, the economic system works as a subcomponent of the ecological system. The production and consumption processes occurring within the economic system generate waste substances and emissions that threaten the ecosystem. As an outcome of economic growth, the degradation of the environment and increased emissions affect today's and future generations to a large extent. Economic growth is defined as increases in Gross National Product (GNP) and therefore, as the continual increase in the level of total production. Due to the components of economic development and growth, there are pessimistic perspectives especially about the fact that the future state of the ecosystem is a cause for concern. When this situation is considered in terms of global climate change, the argument put forward is that in the future, due to the increased emission of greenhouse gases, the reflected radiation will be retained in the earth's atmosphere in larger amounts than today's and the general upward trend in heating will become an unavoidable situation. At this point, the main question is, "On this path that is followed with economic growth and development targets, what will be the extent of the current and future cost or economic loss resulting from global climate change caused by greenhouse emissions?" While in the past, the economic benefits of the use of natural resources and of growth were discussed, nowadays, the anxiety about economic damage caused by global climate change is debated.

Discussed from an economic perspective, the growth factor is a matter of satisfaction that countries will not be able to do without. In this context, the issue of reducing emissions produced by countries has reached an impasse, especially after the Kyoto Protocol. In fact, the process that began with the report on our common future has continued with the Kyoto Protocol and lastly with the Paris Agreement. Nevertheless, the main reason why superpowers like the USA and Russia have not actively participated in the process from the Kyoto Protocol up to the present, and why countries that are party to the protocol have not fulfilled their commitments to reduction is that they have not been able to abandon their growth targets. When countries determined their emission reduction targets within the scope of the protocol, they were in a position to realise this in two ways: (i) by developing renewable energy industries –yet this requires a high level of investment, or (ii) by choosing the savings method, the country could choose technologies that produce fewer emissions in order to enable emission reduction. Underlying both the abovementioned potential positions are countries' preferences and efforts to achieve the emission targets they have committed to. However, the realisation of emission reduction targets requires either the abandonment of today's economic returns for future generations or making large investments in the renewable energy industry sector. It is clear that in both cases, current economic growth will be relinquished. Rather than being merely a question of whether there should or should not be economic growth, this is a mechanism shaped by moral issues between generations in a climate justice and philosophical dimension. In this regard, it is not enough to discuss the issue of global climate change merely within the context of the Kyoto Protocol.

It is generally accepted that the main responsibility for the excessive increase in greenhouse gas emissions that were are faced with especially nowadays, and the fact that they have reached their current proportions, lies with developed countries. Therefore, it would not be wrong to state that when they were creating emission fluctuations while carrying out their production in the past, countries that had achieved their economic growth targets and completed their development were the main agents of global warming originating from human and industrial sources. In this context, the climate change impasse is related to the preferences of developed countries and to the fact that developing or underdeveloped countries were unable to abandon their economic growth.

6. CONCLUSION

Being a pioneer among global powers, and belonging to and living within the standards of developed countries is a desired goal for every individual, society and country. More holistic planning with a balanced model and approaches that will extend national targets from the central to the local level is of great importance. According to Senses (2021), can planning whose existential philosophy has not been adequately grasped be successful? The plan is an element which, when it is followed step by step, both keeps the effectiveness of implementation at the highest level and, by comparing and aggregating implementation results, abstracts the functioning of management. The essence of planning is the isolation of subjective randomness with objective obligations. As well as rationalisation, it has an interventionist approach. In fact, besides being a product of the interventionist socialist system, planning was first born with the aim of serving the process of enabling economic stability. However, when the major objective of growth types which did not include the social phenomenon and were lacking in humanitarian elements became the expansion of the gross national product, this led to deterioration for nature and humans by destroying the quality of life. Economic growth, development and reconstruction are the greatest passion of the age. According to Down (1967), while growth consists of processes related to the expansion of a created structure, development is a wider and more powerful process that encompasses all structures and phenomena related to economic development remaining outside economic structures that can bring about qualitative changes in addition to quantitative processes (Hamitogulları 1980).

The destruction of life-providing elements of nature, global climate change, the pollution of the environment and relationships, industrialisation, and urbanisation enabling aggressive spread by sharp separation from the ecosystem, are only a few of the results emerging from such theories of growth. As in all countries, the economic uncertainties and geopolitical conflicts experienced in the world also affect Turkey, and define the macro-economic conditions experienced by Turkey. This situation, emphasised in the 11th Development Plan, is reflected on the Turkish economy as the expectation of slowdown and inactivity in the manufacturing industry. On the other hand, the uncertainties experienced in the world are shaped not only on the economic and geopolitical planes, but also through the effects of climate change. Besides the identified negative effects of the climate crisis, which are defined under the guidance especially of the United Nations and frequently emphasised by institutions such as the Intergovernmental Panel on Climate Change, and which international protocols such as the Kyoto and Paris Agreements try to avert, it is stressed that the crisis also harbours unforeseen risks. Undoubtedly, the likelihood that Turkey will be negatively affected is inevitable when the situation is evaluated together with the issues of regional inequalities faced by Turkey (MPGM, 2020).

In terms of natural capital, the most important processes in the economic system and ecological system occur with transfers between flows and stocks. In this context, the economic system works as a subcomponent of the ecological system. The production and consumption processes occurring within the economic system generate waste substances and emissions that threaten the ecosystem. As an outcome of economic growth, the degradation of the environment and increased emissions affect today's and future generations to a large extent. In this context:

The economy, development goals, industrialisation, the need for food and space, urbanisation, global climate change, environmental problems and local solutions are in a state of constant interaction with each other. It is possible to observe the reflections of economic targets in a spatial sense. As stated by Lefebvre (2016), thinking constructs a space system, and in fact, by transforming spatial processes first into intellectual and then into physical reality, they are transformed into social, psychological and ecological living space (intellectual, physical and social). In this situation, space and humans have a quality of cyclically nourishing one another.

There is a hegemony in the creation of space. These are the institutions. Spatial legislation processes, laws and regulations come into effect in line with the political viewpoints of these institutions or the guidance of the experts or intellectuals consulted (Lefebvre 2016). Therefore, the intellectual infrastructure for the ecosystem has a leading role both in the formation of spatial systems and in managing environmental crises such as global climate change.

Not only is the effect of spatial planning and urbanisation important for humans' psychological state, but its ecological effect is also important. In this context, especially cultural landscapes included in urban dynamics must be functionalised as carbon sinks that reduce the effect of climate change.

Spatial planning is an administrative tool that nurtures the economic direction of governments. In order to organise the spaces needed for social growth and development, however, the planning hierarchy exists on different scales. In this study, the current state of the planning hierarchy specific to Turkey is presented. It is observed that in its current state, a clear landscape planning system does exist at any level of planning, and that in the Spatial Plans Construction Regulation, landscaping is reduced to the level of social reinforcement. Not only is there a lack of a clear strategy for green areas in the planning hierarchy, but it is also mentioned in the KENTGES reports that cultural landscapes are non-functional and inadequate in urban building stocks.

During the process of functionalising landscapes as carbon sinks, the landscape planning and urban design dimension must be included in the spatial planning hierarchy.

The ecosystem goods and services dimension provided by landscapes is ignored. Accordingly, there is a spatial planning system that is at variance with global climate change reduction and adaptation policies. Instead of this, one of the instruments for the construction of a fairer environment and more sustainable space consists of landscape systems integrated into the city, since landscape systems enable a link to be established between the city and nature.

Not only are there measures and precautions to be taken by each sector due to their internal dynamics, but also, landscapes located at the common point of intersection of earth sciences, ecosystem components and humans are directly correlated with climate change. Other than looking at the green areas in the city with a minimalist approach and only softening the effect of grey concrete, the landscape not only provides all-round benefits for humans with ecosystem services, but also has the function of a carbon sink in burying carbon emissions accumulated in the atmosphere in pedologic and biotic sinks. For this reason, it can be stated that within the scope of adaptation and reduction strategies, there is a strong connection between the landscape and global climate change.

For adaptation strategies aimed at countering global climate change, by means of green networks integrated adaptively into cities in line with earth sciences, the sequestration in carbon sinks of carbon emissions that increase the greenhouse effect by remaining suspended in the atmosphere will provide a great advantage. In this way, by enabling a trade-off between the economy and ecology, an approach will be achieved by which the injustice in the intergenerational ecological debt can be reduced to a large extent.

In terms of historical responsibility, in order not to bequeath an ecological debt to future generations, it is very important that a more liveable and systematic landscape-city integration is provided in local physical plans. As stated by Dede and Şekeroğlu (2020), failure to deal with the spatial planning process holistically leads to unequal development and accelerates the process of deepening of differences between cities in terms of life quality.

Rapid growth, irregular urbanisation, aesthetic problems of urban settlement, global climate change, and the effect of increasing urban heat islands have revealed the necessity of creating green areas in a planned way. In the creation of healthy urban spaces, the role of planned urban green areas, and therefore of landscape planning, is great. The aim is not only to create green areas that have high visual quality; by looking from a larger perspective, in terms of contributing to the reduction of global climate change, landscaping works also provide a high degree of ecosystem service with regard to the management of carbon and climate dynamics. Especially through the medium of urban and rural landscaping, by enabling the absorption of greenhouse gases and carbon dioxide gas created by urban systems and transport, carbon sequestration in the terrestrial system is enabled.

REFERENCES

Dede, O., Sekeroğlu, A. (2020). Türkiye’de Kent Planlamada Mekansal Standartlar Üzerine Bir Değerlendirme. *Humanities Sciences (NWSAHS)* 15 (3): 96–110. https://doi.org/10.12739/NWSA.2020.15.3.4C0238

Dogru, B., Gokalp Alıca, S. (2019). İklim Mücadelesinde Ekonomik, Sosyal ve Ekolojik Adalet. Ankara.

Down, D. F. (1967). Some Issues of Economic Development and Development Planning. *Journal of Economic Issues* 1(3).

Ersoy Mirici, M. (2017). Küresel İklim Değişikliği Çerçevesinde Doğu Akdeniz Bölgesi Ekosistem Hizmetlerinin Karbon Temelli Modellenmesi. Çukurova Üniversitesi. Adana.

Gezim, G, Kiper, H. P. (2016). Türkiye’nin Seksen Yıllık Kent Planlama Serüveninde Son Otuz Yılın Değerlendirilmesi İller Bankası Deneyimi. Ankara: Gazi Üniversitesi Mimarlık Fakültesi, Şehir ve Bölge Planlama Bölümü.

Hamitogulları, B. (1980). Karma Ekonomi, Planlama ve Büyümeye İlişkin Bazı Yanılgılar Üzerine. *Siyasal Bilgiler Fakültesi Dergisi* 35: 167–86. https://dergipark.org.tr/tr/download/article-file/36692

IPCC. (2014). Climate Change 2014 Synthesis Report Contribution of Working Groups I, II and III to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. Switzerland.

KENTGES. (2016). Bütünleşik Kentsel Gelişme Stratejisi ve Eylem Planı. Ankara.

Kılınç, N. (2018). Üst Ölçekli Fiziki Planlar Için Peyzaj Temelli Planlama Dilinin Oluşturulması. Ankara Üniversitesi.

Lefebvre, H. (2016). Mekanın Üretimi. Dördüncü Basım. İstanbul: Sel Yayıncılık.

MPGM. (2020). Türkiye Mekansal Strateji Planı Taslak Kapsam Belirleme Raporu. Ankara.

MSP. (2020). Türkiye Mekansal Strateji Planı Stratejik Çevresel Değerlendirme Kapsam Raporu. Ankara.

Peker, E. Aydın, C.I. 2019. Değişen İklimde Kentler: Yerel Yönetimler Için Azaltım ve Uyum Politikaları. İstanbul.

REC. (2015). A’dan Z’ye İklim Değişikliği Başucu Rehberi.” Ankara.

Schmarsow, A. Fiedler, K. (2017). Mimarlığın Özü ve Mimari Yaratım. İstanbul. Janus Yayıncılık Limited Şirketi.

Senses, F. (2021). Kalkınma İktisadı Yükselişi ve Gerilemesi. İletişim Yayınları.

Smith, P. F. (2005). Architecture in a Climate of Change: A Guide to Sustainable Design. Oxford: Architectural Press.

Tuckness, A. (2018). Locke’s Political Philosophy. The Stanford Encyclopedia of Philosophy.

Usta, G. (2020). “Mekan ve Yer Kavramlarının Anlamsal Açıdan İrdelenmesi.” *The Turkish Online Journal of Design*, Art and Communication - TOJDAC 10: 25–30.

CHAPTER 15

ADAPTIVE REUSE OF OSMAN SHAH MOSQUE IN TRIKALA THROUGH THE LANDSCAPE DESIGN

Mahmood I. ALBRIFKANY[1], Laween HASHIM[2], Assist. Prof. Dr. Pınar BOSTAN[3], Prof. Dr. Şevket ALP[4*], Sardar M. SALIH[5], Karzan ABDULAZEEZ[6], Azad AHMED[7]

---

[1] Nawroz University, College of Engineering, Architecture Department, Duhok, Iraq. E-mail: m3mare@live.com ORCID ID: 0000-0002-0740-920X
[2] University of Duhok, College of Engineering, Architecture Department, Duhok, Iraq. E-mail: ea514laween.malo@gmail.com ORCID ID: 0000-0002-2289-7061
[3] Van Yüzüncü Yıl University, Faculty of Architecture and Design, Department of Landscape Architecture, Van, Turkey. E-mail: pinaraslantas@yyu.edu.tr ORCID ID: 0000-0002-8947-1938
[4*] Van Yüzüncü Yıl University, Faculty of Architecture and Design, Department of Landscape Architecture, Van, Turkey. E-mail: alpsevket@gmail.com ORCID ID: 0000-0002-9552-4848
[5] University of Duhok, College of Engineering, Architecture Department, Duhok, Iraq. E-mail: sardaror@gmail.com ORCID ID: 0000-0001-6174-4570
[6] University of Duhok, College of Engineering, Architecture Department, Duhok, Iraq. E-mail: architect.karzan@gmail.com ORCID ID: 0000-0002-7351-9642
[7] Salahaddin University, College of Engineering, Architecture Department, Erbil, Iraq. E-mail: barzanchiazad@gmail.com ORCID ID: 0000-0001-9427-3920

INTRODUCTION

Greece was under the Ottoman rule for four centuries. Historical mosques in Greek are unique buildings that have high cultural values and represent the architectural heritage of Islamic, Ottoman, and Greek civilizations. There are a lot of historical Ottoman mosques in Greece which have a high potential for redesign/reuse. Most mosques, tombs, and graveyards in Greek are ruined by earthquakes and others have been neglected due to the Greek economic crisis and political reasons. All these factors led to the close of several mosques. Turkish Cultural Association mentioned that "Greece makes the Muslim foundations bankrupt and Athens authorities forced these foundations to sell their properties despite international agreements". These mosques must be restored to preserve Ottoman heritage and Islamic identity.

The research aims to get an appropriate function for the Osman Shah Historical Mosque in Trikala, by applying landscape design. The term adaptive-reuse refers to the reuse/redesign of the old building for a new purpose. The redesign/reuse has environmental, social, and economic benefits for the state and its people. This study aims to make a redesign for the surrounding of the historic Osman Shah Mosque through landscaping. In this way, the landscape design proposal for the preservation of Ottoman historical and cultural heritage value with adaptive reuse has been developed.

To restore these historic mosques sustainably for the long term, it is required to give the building a new function besides the worship, such as a museum. The following questions arise:

- The first question: how should the landscape design be through the Osman Shah Mosque?
- The second question: can we use the Osman Shah Mosque by proposing different functions?

These two basic questions will be evaluated to preserve the historical and cultural Ottoman-Islamic identity, and suggestions will be presented specifically to the Osman Shah Mosque.

1. BACKGROUND INFORMATION

1.1. Conservation of Historical Mosques

Based on the meaning of the word ‘conservation’ in Oxford Learner’s Dictionaries, which is “the official protection of buildings and objects that have historical or artistic importance. Also, it is the conservation of ancient monuments for our cultural heritage”.

Conservation “is the action taken to prevent decay and manage change dynamically. It embraces all acts that prolong the life of our cultural and natural heritage, the object being to present to those who use and look at historic buildings with wonder the artistic and human messages that such buildings possess” (Feilden, 1994).

There is a difference between conservation and restoration. Structurally, restoration and conservation are carried out without destroying the historical architectural features of the building. Functionally, restoration means keeping the same function of the building even if it does not work. While conservation refers to converting the function of the building to a new function to prevent it from being wrecked/decayed by applying some changes in the building. These changes aim to support the new function (Asoobar, 2009). In this study, we will use the conservation approach for Osman Shah Mosque.

Cultural diversity, perception, and consciousness are led to concentrate on the conservation term (Jokilehto, 1999). Today, historical conservation is more accurate and covers the large and small elements of the building (Fitch, 1990).

The conservation must be conducted by a professional team which has different disciplines and high skilled personal in it such as planner, landscape architect, surveyors, urban designer, conservation architect, engineers (water, sanitary, electric, and civil), contractors, craftsmen, archaeologist, geologist, seismologist, art historian, biologist, chemist, and physicist (Feilden, 1994).

Conservation of the historical places "have physical, environmental, social, cultural and economic impacts” (Orbaşlı, Architectural Conservation, 2008) (Orbaşlı, 2002). Architectural conservation includes some interventions (Kolo, 2015). Conservation aims to extend the physical lifespan of the building (Parks Canada, 2010). Furthermore, the goal of this process is to upgrade the lifestyle of the people instead of restoring mortar. Nowadays, the historic building has been inserted with a new function (Uffelen, 2011).

If the original function of the historical building hasn't served the purpose of the building, the conservation process should be about changing or shifting the function of the building to be used by users. The conservation has to reflect the identity, the culture of the community and meets the new needs of the people.

Conservation of the historical building "contributes to sustainability and increasing the ecological realm of the environment" (Pearson, 1999). Several historical mosques are abandoned or ruined or deteriorated or closed worldwide. The repair cost of some mosques is no longer sustainable. James Douglas mentioned that "The stock of churches and mosques are now well excess of demand" (Douglas, 2006). Historical mosques are evidence of Muslim intervention in previous art and architecture. These buildings have religious, social, economic, cultural, historical, and aesthetic values.

There are similarities between the goals of the conservation of historical mosques and the adaptive reuse of the historical mosques. Both are aimed to conserve the historical mosques in a sustainable way where it includes the function and the structure of the mosque.

1.2. Adaptive Reuse of Historical Mosques

It is known that constructing a new building becomes expensive more than conserving the historic building. Also, the land is expensive and it is difficult to find empty land in the urban city. In addition, demolishing the old or historical building and constructing a new structure is a waste of time, funds, efforts and it is not a sustainable approach. The historical buildings are landmarks in the urban and rural regions.

Based on the meaning of the word 'Adaptive Reuse' in Merriam Webster Dictionary, it means the renovation and reuse of pre-existing structures for new purposes. The adaptive reuse term is a plan for re-using abandoned buildings and sites. Where, the economic, social, aesthetic, and cultural values of these buildings will be increased (Burchell, 1981). Adaptive reuse "is more than the conservation of a property for a new or continued use" (Latham, 2000a) (Latham, 2000b).

Adapting or reusing the historical building is a big challenge where there is a need to change the building, restorative, and reuse it (Loures, 2007). The idea of reusing the historical building is an environmentally friendly and sustainable approach (Douglas, 2006). The reuse of the building aims to create a new function for the building without destroying the historical value of the building (Greffe, 2004) (Harun, 2011). Changing the function of the historical building needs to respond to the surrounding factors and context (Loures, 2007). Using landscape design has a high environmental impact. The historical building needs a professional designer to find out a unique solution for this type of complicated buildings (Jacobs, 1961).

The adaptive reuse of the historical mosque is a very sensitive object due to its religious, historical, cultural, social, and political value.

Adaptive reuse should be done carefully so as not to attract the reaction of religious activists and the public.

1.3. Historical Mosques

The mosque is a holy building for Muslims and it is built for worship purposes (praying and gathering people). The original word is derived from the Arabic word masjid (Sajda) which means prostrate. Also in Arabic, it is called Jami that means gathering people (Collins, 2003).

The main architectural features of the mosque are the minaret, the courtyard that contains the fountain water, and the prayer hall (Greebstein et al., 2006). The minaret is used to be calling people to the prayer. The courtyard is used for gathering Muslims for praying Friday prayer and for other activities that need to assemble people (Grube, Architecture of the Islamic world, 1978a) (Grube, 1978b). The fountain is used for Islamic Ablution (Norberg- Schulz, 1986). The prayer hall is used for praying activities (Cambridgedictionary, 2015).

In general, the mosque has three plan types (patterns) as follows (Kamiya, 2006):

- The Hypostyle mosque: It consists of a hypostyle prayer hall and a columned courtyard (Stegers, 2008).
- The four-iwan mosque: It consists of a prayer hall and four-iwan surrounding the centralized courtyard (Baer, 1989).
- The centrally-planned mosque: It consists of a centralized-domed prayer hall and a courtyard (Ring, 1995); (Watenpaugh, 2004).

The most common characteristic in the historical mosque is the closing from the outside (enclosure) and opening to inside which appears obvious from the courtyard.

Muslims are striving to bring beauty to their houses, palaces, and surrounding mosques. From the Islamic perspective, people are trustees and stewards of the earth and they have to respect nature, conserve all forms of life, and build a green Islamic sustainable architecture (Al-Jayyousi, 2018).

1.4. The Green Landscape of the Historical Mosques

In general, green is a symbol of nature and life in most civilizations and especially for those who have lived in deserts. It has also the same symbolic meaning in Islam. The green color has appeared in Prophet Mohammed's clothes (green cloak and turban), he was covered with a green garment when he died. In addition, the Quran's Ayat describes paradise as a green place. Moreover, this color has been used in the binding of Qurans, flags of an Islamic country/ parties, fonts, plant ornamentations, domes of shrines, and mosques (Beam, 2009).

The green color of Islam has used in the roof and minaret of the Qarawiyin Mosque in Fez, Morocco which has built-in 857 (Figure 1).

Figure 1. The roof (left image) and minaret of the Qarawiyin Mosque (right image) in Fez, Morocco (URL 1)

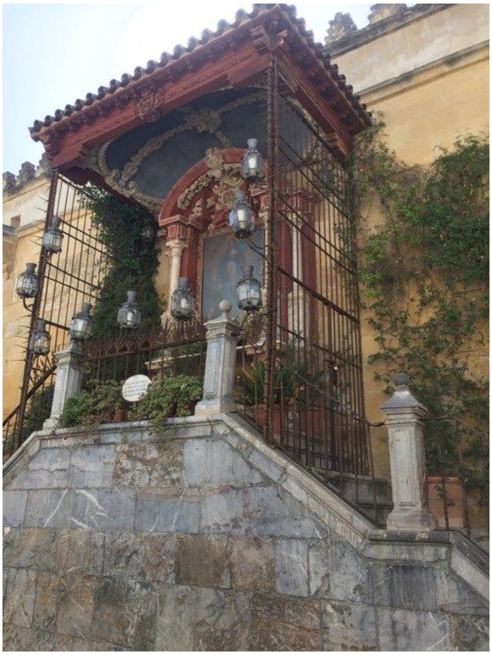
In mosques, symmetric form, radial composition, and formal principles are the most common characteristics in the landscape of the historical mosques. Muslims have brought greenery and aesthetics ambiance to the courtyard of the mosque (Mirmobiny, 2015).Green gardens, trees, and fountains in the courtyard are evidence/ witnesses of the significance of the landscape in the mosques' architecture like a Great Cordoba Mosque in Spain which has converted to a mosque in the 15th century (Figure 2).

Figures 2. Great Mosque of Cordoba (URL 2; URL 3). Left image represents bird-eye view and right image represents ground view.

During the Umayyad period-the first Islamic dynasty (6th to 9th century), plants have appeared in the courtyards of the mosques such as the fruit trees and plants in the Great Mosque of Cordoba in Spain which has rebuilt 785-786 (Figure3).

Nowadays, the ivy plants are ornamenting the porch (gate) of the Great Mosque of Cordoba as it is shown in the Figure 4.

Figures 3. Fruit trees and plants in the Great Mosque of Cordoba in Spain from two perspectives (URL 3; URL 2)



Figures 4. The ornamenting the porch (gate) of the Cordoba Mosque with ivy plants (URL 4)

Another example is from Turkey. The Green Mosque (Köprüköy Mosque) is built in 1930 and it’s located in Adana, southern Turkey, 20 miles far from the Mediterranean Sea. Ivy plants are covering all external walls and minaret and the green is shaping the building (Figure 5). This mosque is the greenest historical building in Turkey and looks like a leafy garden. Also, it has a colorful flower garden which is used for pray during the summer season (Ihlas.Haber.Ajansi, 2019).

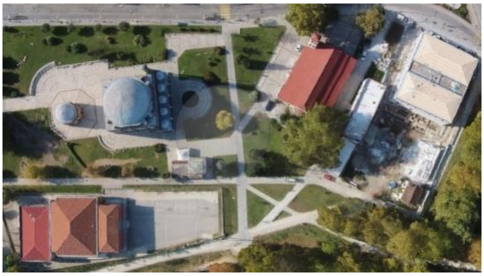
Figure 5. The Green Mosque in Adana covers with the Ivy plant (URL 5)

According to the protection and maintenance association of this mosque, the last restoration has happened in 1965. This Green Mosque is the destination of Turkey visitors (Figure 6). Where its green color and colorful flowers attracting people to visit or praying inside this building (Anadolu-Agency, 2014).

Figures 6. The green colour and colourful flowers are covering the mosque (URL 6; URL 7)

2. MATERIAL OF THE STUDY

Osman Shah Mosque, also known as Kursum Mosque and Kara Osman Pasha, was built between 1550 and 1560 in Trikala, Greece (39°33′0.38″N 21°46′16.13″E). The mosque had been built by the most famous Ottoman architect Mimar Sinan and under the order of the Osman Shah (the governor of the Trikala), who was the son of one of Sultan Selim I's daughters (Figure 7). Osman Shah Mosque is the only mosque that Mimar Sinan designed in modern Greece. Evliya Çelebi reported that, the Osman Shah Mosque is the only surviving mosque of at least eight mosques in Trikala. Except for the octagonal tomb, all other buildings connected to the mosque have not survived to the present day. The mosque is protected by UNESCO (Wikipedia, 2021). The mosque is an important cultural value because it is a building belonging to Mimar Sinan and is one of the last remaining examples of Ottoman architecture in Greece.

Figures 7. The big dome is covering the mosque hall and the small covers the tomb (URL 8). Google Earth. Left image represents the ground view and the right image represents a bird-eye view of the mosque.

The Ottoman-style is the characteristic feature in this mosque where it has a centrally planned type (Figure 8). The building consists of a squared prayer hall covered with a central semi-spherical dome with 18 meters diameters, and the arched portico is located in front of the prayer hall and covered with five small domes. The entrance is located in the northern-west of the building. The ashlar minaret is located on the northwest corner without the roof.

Alternating layers of brick and stone have been used in this structure. There was an attached school (madrasa) and alms-house which all have vanished. The octagonal domed building is used as a storage site for storing artifacts. The mosque is been used as a venue for some events and it’s no longer used for praying (Necipoğlu, 2005).

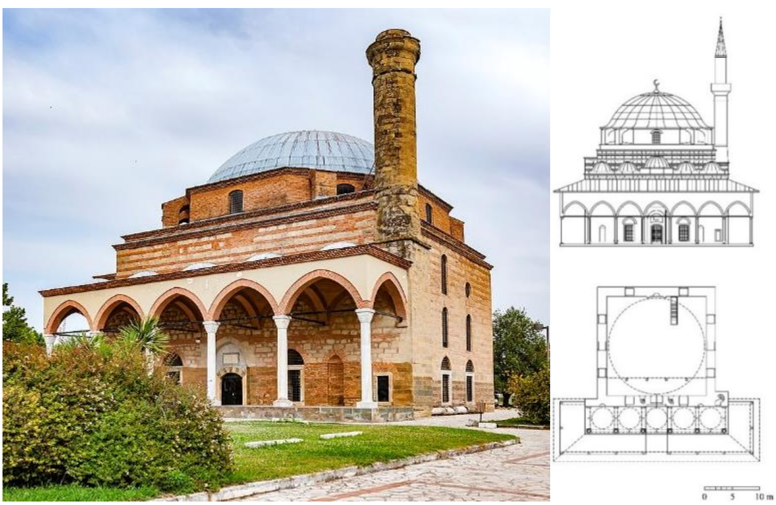


Figure 8. The perspective, elevation, and the plan of the Osman Shah Mosque (URL 9; URL 10). Left image represents the ground view and the right image represents the plan view of the mosque.

The reuse potential of Osman Shah Mosque is based on the building characteristics in general, its location, architectural features, and structural situation. According to the style of this mosque, the solution is to add plants to the surroundings and shape the courtyard. The action of adaptive reuse has to respect the surroundings and responds to the required needs of the users. Adaptive reuse and re-functioning approaches have been used in the conservation process.

3. RESULTS AND DISCUSSION

A proposal design has been developed for the Osman Shah Mosque (Figure 9). In the design, the Cupressus trees will be used mostly at the surrounding mosque, as the tall trees will be raised far from the structure of the mosque. The longitudinal form of the trees is inspired by the pencil minaret of Turkish. The minaret element will be conserved without a green decoration. The top of the minaret will be reconstructed according to the original shape and based on the Turkish pencil minaret style. The courtyard is planned and designed to surround the mosque and the tomb from four sides. The rhythm of the arched galleries is a main Turkish-Islamic element. Also, the courtyard is a primary Islamic characteristic feature that will surround the mosque from two sides. A courtyard has been proposed to serve as an assembling area for gathering people during Friday prayer and also for events and cultural activities. These proposed courtyards will be surrounded by arched galleries from four sides. The existing fountain will be centred on the proposed courtyard. This formal garden of the mosque is a place of relaxing and comforting. The landscaping of the historical mosque represents people living in harmony with natural elements.

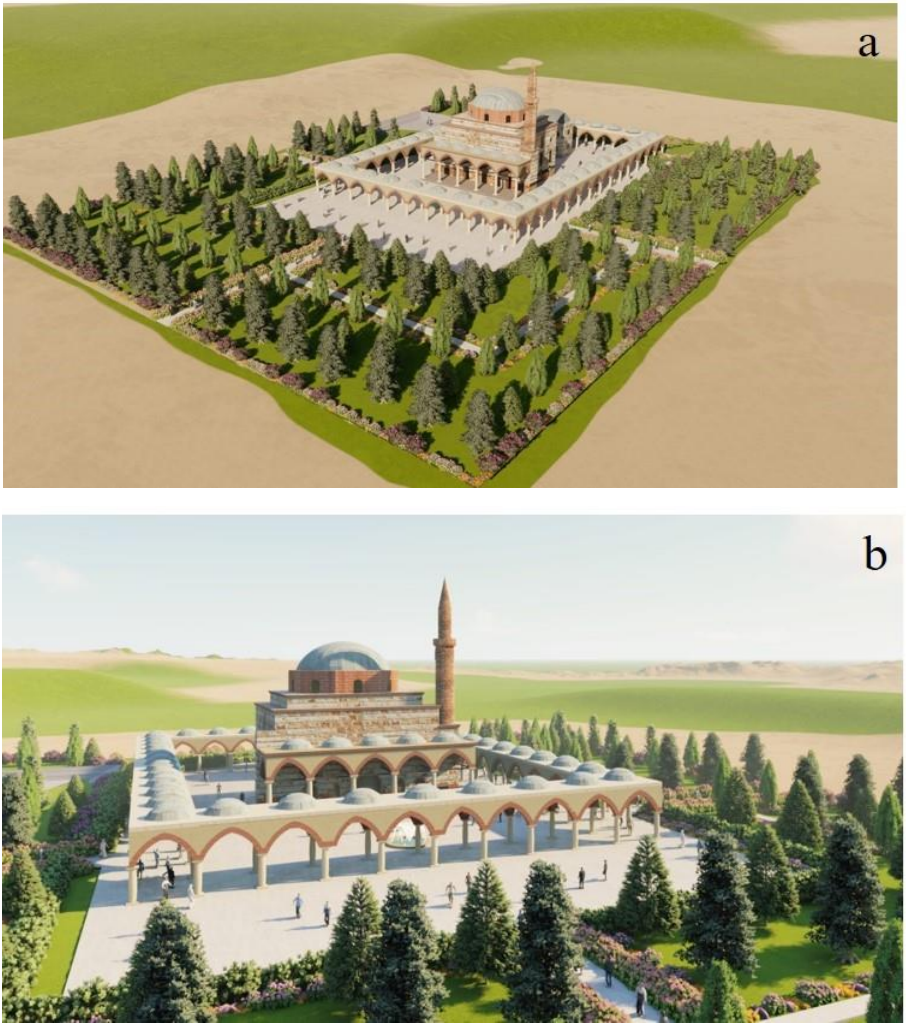


Figure 9. (a, b, c, and d) The proposal design of the Osman Shah Historical Mosque in Trikala, Greece, seen from different perspectives

The proposal design that has been developed for the adaptive reuse of the Osman Shah Mosque is an answer to the question "Can we use these historical Mosques by proposing different functions besides the worship?" The decision for the conservation of this historical mosque has been conducted as; the internal and external architectural features will be conserved. It is suggested that the building is to be reopened as a mosque and museum place.

The landscape design of the site has been designed to take the tourists on a long tour around this historical mosque and tomb to see all features from all sides. By implementing this project, the worshipers can use the mosque for their prayers, and tourists will come to visit this historic building. It will have positive economic and social effects. The originality of the building will be respected.

The landscape pattern of this intervention is inspired by the courtyard (a forest of columns) in the mosque. This type of design will be attractive to its visitors and Muslims during the mosque's open hours. The Ivy plant and trees will be a semi-private space (semi-public or a common space) between the mosque and the surrounding area and it can be used for gathering people to conduct various activities. Also, it strengthens the axes of the mosque, defines the entrance of the building and the Qibla (praying direction).

4. CONCLUSION

There is an urgent need to pay special attention to historical mosques in Greece and to reuse these heritage buildings with adaptation. Otherwise, these structures will be abandoned and destroyed due to negligence. The adaptive process transfers the culture of society from the past to the present time. This contemporary approach will assist to solve the problem of the abandoned mosques and extend the lifespan of these heritage buildings. Also, the new function will be a response to the user needs and an example of applying sustainable development in historical architecture. There are economic, social, and cultural benefits by applying this type of adaptive reuse. The intervention in the Osman Pasha Mosque is a good example of the minimum intervention, landscape design, and adaptive reuse of heritage buildings as significant aims of sustainability, and heritage conservation.

This historic building will serve the society as a mosque for worship and as a museum that transmits Ottoman Islamic history to future generations. Mosques, especially in places where Muslims are in a minority, serve as a cultural and educational centre for the Muslims living in that country (Akın, 2016). When evaluated from this point of view, the restoration of historical mosques and their re-use by gaining new functions is also a socially and culturally important phenomenon.

REFERENCES

Akın, A. (2016). Tarihi süreç içinde cami ve fonksiyonları üzerine bir deneme. Hitit Üniversitesi İlahiyat Fakültesi Dergisi 2016/1, c. 15, sayı: 29, ss. 179-211.

Al-Jayyousi, O. (2018). *Story/ Ecosystems and Bıodıversıty*. https://www.unenvironment.org/news-and-stories/story/how-islam-can-represent-model-environmental-stewardship

Anadolu-Agency. (2014). *İbrahim Erikan, wêne*. https://www.aa.com.tr/kk/pg/galeriya-w%C3%AAneyan/mizgefta-bi-lavlavk%C3%AA-xemiliye-disibe-bexceyek%C3%AE-botan%C3%AEk#

Asoobar, N. (2009). A comparative assessment of the design approaches for the conversion of historic residential buildings. *EMU, North Cyprus, Famagusta*, 12.

Baer, E. (1989). *Ayyubid metalwork with Christian images* (Vols. Vols. Muqarnas, Supplements series, studies in Islamic art and architecture). Brill.

Beam, C. (2009). *Islamic Greenwashing*. Retrieved from slate.com/news-and-politics: https://slate.com/news-and-politics/2009/06/why-is-the-color-green-so-important-in-the-muslim-world.html

Burchell, R. &. (1981). *The adaptive reuse handbook: procedures to inventory, control, manage, and reemploy surplus municipal properties.* New Brunswick, N.J: Rutgers University, Center for Urban Policy Research.

Cambridgedictionary. (2015). *Prayer hall*. Retrieved from Cambridge dictionary: dictionary.cambridge.org

Collins, W. C. (2003). *Church, Basilica, Mosque, courtyard*. Retrieved 2003, 2012, 2016, from In Collins English dictionary: www.collinsdictionary.com

Douglas, J. (2006). *Building adaptation.* Heriot-Watt University, Edinburgh, UK: Elsevier Ltd.

Feilden M, .. B. (1994). *Conservation of Historic Building.* London: Reed Educational and Professional Publishing Lt.

Greebstein et al. (2006). *What do our neighbors believe?: Questions and answers on Judaism, Christianity, and Islam.* (H. H. Greebstein, Ed.) Louisville: Westminster John Knox press.

Greffe, X. (2004). Is Heritage an Asset or a Liability? *Journal of Cultural Heritage*, 301-309.

Grube, E. (1978a). *Architecture of the Islamic world.* New York: William Morrow and company Inc.

Grube, E. (1978b). *What is Islamic Architecture? In G. Michell, Architecture of the Islamic world: Its history and social meaning.* London: Thames & Hudson.

Harun, S. N. (2011). Heritage Building Conservation in Malaysia: Experience and Challenges. *Elsevier: Procedia Engineering 20*, 41-53.

Ihlas.Haber.Ajansi. (2019). *haber*. Retrieved from memurlar.net: https://www.memurlar.net/haber/827883/

Jacobs, J. (1961). *Death and life of great American cities.* New York, NY: Random House.

Jokilehto, J. (1999). *A History of Architectural Conservation.* Italy: ICCROM.

Kamiya, T. (2006). *Architecture of Islam, its charm and elucidation*. Retrieved from ne.jp: http://www.ne.jp/asahi/arc/ind/1_primer/types/typ_eng.htm

Kolo, D. N. (2015). *Adaptive Re-Use Potentials of Post Office Buildings as Examples of British Colonial Heritage in Nigeria and North Cyprus* (Doctoral dissertation, Eastern Mediterranean University (EMU)-Doğu Akdeniz Üniversitesi (DAÜ).

Latham, D. (2000a). *Creative Re-Use of Buildings* (Vol. 1). Donhead, United Kingdom: Routledge.

Latham, D. (2000b). *Creative Re-Use of Buildings* (Vol. 2). Donhead, United Kingdom: Routledge.

Loures, L. (2007). *Sustainable reclamation of industrial areas in urban landscapes. Sustainable Development and Planning III.* Southampton, UK: WIT Press.

M. Fitch. J. (1990). *Historical preservation.* United kingdom: Donhead Ltd.

Mirmobiny, S. (2015). *humanities/art and history*. Retrieved from khanacademy: https://www.khanacademy.org/humanities/ap-art-history/early-europe-and-colonial-americas/ap-art-islamic-world-medieval/a/the-great-mosque-of-cordoba

Necipoğlu, G. (2005). *The Age of Sinan: Architectural Culture in the Ottoman Empire*. London: Reaktion Books.

Norberg- Schulz, C. (1986). The architecture of unity. In Architectural Education in the Islamic World. *Aga Khan Award for Architecture*, 9. Retrieved from https://archnet.org/publications/3624

Orbaşlı, A. (2002). *Tourists in historic towns: Urban conservation and heritage management.* London: Taylor & Francis.

Orbaşlı, A. (2008). *Architectural Conservation.* UK: Blackwell Publishing.

Pearson, M. &. (1999). *Looking after heritage places. The basics of heritage planning for managers, landowners and administrators.* Melbourne: Melbourne University Press.

Ring, T. R. (1995). *International Dictionary of Historic Places* (Vol. 3). Southern Europe: Taylor & Francis.

Stegers, R. (2008). *Sacred buildings: A design manual.* Springer Science & Business Media.

Uffelen, C. (2011). *Re-Use architecture.* Switzerland: Braun AG.

Watenpaugh, H. Z. (2004). *The image of an Ottoman city: Imperial architecture and urban experience in Aleppo in the 16th and 17th centuries* (Vol. 33). Leiden: Brill, Armenian Research Center collection. Retrieved from https://quod.lib.umich.edu/cgi/t/text/text_idx?c=acls;cc=acls;view=toc;idno=heb05840.0001.001

URL 1. www.lensculture.com

URL 2. www.khanacademy.org

URL 3. www.artencordoba.com

URL 4. www.theyearaway.com

URL 5. www.sozcu.com.tr

URL 6. www.fotogaleri.haberler.com

URL 7. www.m.yeniakit.com.tr

URL 8. www.greece.com

URL 9. www.en.wikipedia.org

URL 10. www.archnet

CHAPTER 16

BENEFIT FROM VEGETATION IN HIGHWAY PLANNING AND LANDSCAPE ENGINEERING

Prof. Dr. Murat Ertuğrul YAZGAN *

* Siirt University, Faculty of Agriculture, Department of Landscape Architecture, Siirt, Turkey. E-mail: me-yazgan@hotmail.com ORCID ID: 0000-0003-3014-8367

INTRODUCTION

Open and green areas have an important and priority place in urban planning in countries that have reached a modern level in social, economic and technological aspects. The development plans, which will realize the planned urbanization phenomenon in our country in recent years, also endeavor to provide the biological environment necessary for the physical structure of the city.

The effort to plant parks, gardens, playgrounds and areas where sports activities will be held in city centers and its immediate surroundings is no longer considered a luxury but a necessity of social and cultural city life.

Now, designers and planners are aware that architectural work, urban design or a highway will look more beautiful when integrated with green, and offer a more peaceful and safer living environment to people and society. Landscape architects who are in an effort to create a biological environment in the physical environment and those who make an effort in this regard establish green areas by making use of inanimate materials within the framework of scientific and aesthetic principles.

1. GREEN AREAS, TURF SURFACES AND THEIR BENEFITS

Grass areas, which have a relaxing and creative effect on human beings during both the plan and the implementation process, and that present a simple transition between the mass and the surface in the landscape, form a lively soil cover (Orçun, 1979). Because of this basic idea, which is correct and beautiful, the use of excessive amounts of grass seeds in landscape planning and application studies has started to be used in areas that will have negative results in functional terms. Such practices, in which aesthetic thinking overrides functional concerns, cause failure in the green area facility and cause economic damages to reach a great extent.

It is erroneous to think that the lawn facility consists only of the cultivation and fertilization of the soil and the planting of grass seeds purchased elsewhere on the field, and the occasional watering of this area. Because grass areas should be considered as a long-lasting green cover that requires continuous maintenance measures and requires much labor and money, apart from a good facility preparation at the beginning. Achieving success in the lawn facility is possible with the correct purpose and selection of species suitable for ecological environment conditions, using quality seeds and continuous maintenance (Orçun, 1979) (Figure 1).

Figure 1. Road maintenance (URL 1)

In the grass field facility, although the grass seed is unnecessarily wasted and it has an alternative functionally, the last place where aesthetic thought will be considered is the medians on the roads in the city and its close vicinity. In recent years, especially in our metropolitan cities, in the main arteries and highway medians that connect with other cities, the necessary soil preparation and some maintenance conditions have been met with appropriate grass seed varieties and mixtures, but the established grass areas are renewed and repaired every year. The grassy medians (Figure 2), which have a beautiful appearance at the beginning, splash the muddy waters full of dusty and exhaust gas residues accumulating on the road in winter and rainy weather from the wheels of motor vehicles. There is no trace of that beautiful image during the winter. Visual damage throughout the winter gives way to economic losses in the spring months (Figure 3). Grass plants whose leaves are plastered with oily and poisonous mud lose their green color because they cannot perform photosynthesis, while the toxic water that passes into the soil disrupts the chemical structure of the soil, shortening the life span of grass plants even more. Particles coming out of the exhaust of motor vehicles in traffic and adhering to grass plant leaves in spring and summer bring up an important health problem.

Figure 2. Highway vegetation (URL 2)

Figure 3. Road maintenance (URL 3)

2. PLANT MATERIAL IN PREVENTING TRAFFIC NOISE

In areas with low building density in the city and especially outside the city, the expropriation strip on the roadside can be covered with suitable plants to reduce the spread of noise significantly. These measures also apply to the area around airports and railways. Although the plant material has limited noise absorption and dispersion properties, its psychological effects are pronounced. Because, the negative effect of noise, whose source is seen and can be identified, on people is quite high.

When the sound, which has the feature of spreading vibrations in the atmosphere, encounters an obstacle, some of it is swallowed and some of it is reflected according to the characteristics of the obstacle. This is called noise.

Considering the size of the leaf, the way the leaf is attached to the branch, the density of the leaf or needle, the frequency of branching, the stem and branch texture of the plant, a more economical and more beautiful noise prevention barrier can be made by choosing plants that are resistant to exhaust gases and have more noise-preventing effects.

Sound barriers made with non-living material, slopes that occur by lowering or raising the road elevation, are made more effective and beautiful in noise prevention by using plant material (Figure 4 and Figure 5).

Figure 4. Noise barrier with live and non-living material (URL 4)

Figure 5.Noise barrier (URL 5)

3. CONCLUSION

Grass areas, which have one of the highest costs according to unit prices of landscape architecture services, have an average of ten years of life with good care, according to experience and observations in parks and gardens, even if all kinds of negative factors are considered.

In addition to human health and economic trouble, irrigation is one of the unimportant problems that need to be solved in terms of traffic flow. As a result of the insufficiency of technical specifications or the inability to control the application, wetting of the sprinkler irrigation heads in dry and hot weather and the wetting of the road surface can cause danger by causing the moving vehicles to slide or sudden steering maneuvers with the idea of running away from the water.

As a result, considering the technical and administrative obligations, if there is a need for grass area in the medians, special technical specifications should be prepared in more detail. Considering the climate and usage conditions of the turf species and mixtures, it is necessary to specify the germination percentages and purity, to determine the physical, chemical and organic values of the median top soil as a prerequisite and to include at least one year maintenance obligation in cost calculations.

Although the unit cost of the first facility in the lawn areas is very low compared to the plant arrangement unit cost with trees and bushes, it is a big disadvantage that they are not functional with the maintenance costs required later. The functions of median regulations are traffic safety (preventing and mitigating accidents), preventing dusting with soil retention, warning with signal effect and aesthetic appearance. Grass areas prevent soil flow and dusting and provide an aesthetic appearance by creating only a surface among these functions. Trees and shrubs are preferred because of their characteristics such as reducing the effect of headlight lights and performing other functions, resisting all kinds of environmental damage more than grass plants, creating color and texture richness according to the seasons. In addition, if they are used together with grass, partial shading of trees and shrubs on the lawn will reduce the water loss caused by evaporation and these plants will benefit from the water that descends from the surface to the lower layers. For this reason, it will be an aesthetic and functional necessity to widespread the use of shrubs and trees suitable for ecological conditions in urban medians with appropriate grass facilities as small as possible.

REFERENCES

Açıksöz, S. 1991. Egzoz Gazlarının Bitkiler Üzerine Etkisi. AÜZF Peyzaj Mimarlığı Bölümü, Çevre Etkileşim Değerlendirmesi, Ankara.

Orçun, E., 1979. Özel Bahçe Mimarisi, Ege Üniversitesi ZF Yayınları, No: 152, Yardımcı Ders Kitabı II. Baskı, İzmir.

URL 1. Karayolu bakımı. https://foto.haberler.com/haber/2015/04/13/d-400-karayolundaki-kavsaklarda-bitkilendirme-7186863_x_o.jpg

URL 2. Karayolu bitkilendirmesi. https://www.alanya.bel.tr/Photos/News/Big/347340896.JPG

URL 3. Karayolu bakımı. https://www.ozgursesgazetesi.com/wp-content/uploads/2018/07/aliaga-belediyesi-ref%C3%BCj-bitkilendirme-7.jpg

URL 4. Canlı ve cansız malzemeyle gürültü bariyeri. https://encrypted-tbn0.gstatic.com/images?q=tbn:ANd9GcT0xBiCfJL2GExyAI5PER92BBTTtQBwSEzSlzX8zqKjdQIikYdMJhrdgzMYVG9a209teogandusqp=CAU

URL 5. Gürültü bariyeri. https://ytong.com.tr/img/user/blog-gurultu-bariyeri-3.jpg

İKSAD
Publishing House

ISBN: 978-625-7636-65-0