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Urban Identity and Environmental Perception in Annaba, Algeria

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ABSTRACT

The city is the space where human beings live, and where they are satisfied to find all their needs in presence such as settlement, residential accommodation, work places, recreation and entertainment are satisfied, services are provided. Because of the different social and cultural aspects, cities are marked by an urban identity which differs from one place to another. Therefore urban identity is a very important concept which is defined in several ways but the best known diffinition is that of Lynch who defined it as follows: “the extent to which a person can recognize or recall a place as being distinct from other places”(Lynch ,1968). Annaba, classified as the fourth largest city in Algeria, because of its geographical location, as well as its very rich history, it is a city which has a striking and very special urban identity which comes from the Ottoman and Colonial periods in the first place, more that many other civilizations lived in Annaba. These civilizations have left their mark on the urban landscape and the natural environment of the city. The aim of this study is to evaluate the city of Annaba on various aspect envirenementale, historical, urban (payesage and natural), cultural and social, in order to know the elements that participated in the formation of urban identity of the city of Annaba, this city must be taken into considiration from the algierienne autaurité, in what is a very important city which can be a tourist by paul excilence.

Anahtar Kelimeler:
Annaba şehri.
Kent Kimliği.
Çevre.
Peyzaj.
Sosyo-Kültürel.

ÖZ

Kent, insanın yaşadığı, mevcudiyet, barınma, barınma, iş yerleri, dinlenme ve eğlence gibi tüm ihtiyaçlarını karşılamak için tatmin olduğu, hizmetlerin sağlandığı yerdir. Farklı sosyal ve kültürel yönleri nedeniyle şehirler, bir yerden diğerine ve bazen bir bölgeden diğerine farklılık gösteren bir kentsel kimlikle işaretlenir. Bu nedenle kentsel kimlik, çeşitli şekillerde tanımlanan çok önemli bir kavramdır, ancak en iyi bilinen ayrım, onu “bir kişinin bir yeri diğer yerlerden farklı olarak tanıma veya hatırlama derecesi” şeklinde tanımlayan Lynch'inkidir. Coğrafi konumu ve çok zengin tarihi nedeniyle Cezayir'in dördüncü büyük şehri olarak sınıflandırılan Annaba, başta Osmanlı ve Koloni dönemlerinden gelen çarpıcı ve çok özel bir kentsel kimliğe sahip bir şehirdir. Annaba'da daha birçok uygarlık yaşadı. Bu uygarlıklar kent peyzajına ve kentin doğal çevresine damgasını vurmuştur. Bu çalışmanın amacı, Annaba kentinin kentsel kimliğinin oluşumunda rol oynayan unsurları tanımak için Annaba kentini çevresel, tarihi, kentsel (peyzaj ve doğal), kültürel ve sosyal çeşitli açılardan değerlendirmektir. Bu şehir, paul excilice tarafından turist olabilecek çok önemli bir şehir olan algierienne autarité'den alınmalıdır.

1. Introduction

F. Choay (1972) says, in the ancient 1970s, considering the city as a "non-verbal system of indicating elements" (Choay, 1972). The city shows as a space created and crossed by dynamics, demonstrations, images and actions, but also

as a "methodical pluridimensional organization". From these quotes, from what F. Choay declares we can comprehend that : cities are places where human exigencies such as: settlement, residential conditioning, work places, entertainment and diversion are satisfied, services are provided. Social and cultural characteristics of the city are the most important countenance, which are in a continuous development [1].

On another side, corresponding to Webster's Ninth New Collegiate Dictionary (1983), identity is "the distinguishing character or condition of a person or a thing". Lynch (1981) also defines identity as "the extent to which a person can recognize or recall a place as being distinct from other places". Therefore, like individuals, cities should have character and distinctions; like individuals, this flavour is made up of countless characteristics, or identifiable elements [2].

We can also define urban identity as the result of attachment to an urban space accompanied by social investment. It is the fruit of the interrelationship that the individual maintains through his practices within the urban fabric that is to say through the direct experience of the environment, and of a social construction resulting from communication [3]. Thus, urban identity can be defined as the procedure of ordering and structuring all of the representations that the diverse internal and external social groups of a city have of it, its past, its present and of its future, and this at a given moment in history.

Historic and open, ANNABA has witnessed the passage of very great civilizations which have marked its history and its experience and which have left behind a heritage of remarkable richness which constitutes a true open-air museum. Bouna (Annaba), has accumulated a cultural capital richly adorned by the culture of the civilizations which, have administered it and which have passed by, leaving cultural stratifications which contributed to the construction of the identity of this thousand-year-old place which, despite the neglect, has been able to resist the destruction and erasure of a territory several thousand years old, some of whose identity references are intimately linked to the history of this Medina. The identity of the Medina of Annaba, built over the long term, is based on multiple dimensions, spiritual, cultural and urban. However, with the action of colonization, a dramatic break took place between these intangible dimensions, which «migrated» and their unstructured urban support remodeled for exogenous uses [4].

This study aims to recognize the elements of sub-identity of a historic part of the city and to determine its limits. As a result, the search for regional revitalization methods will be possible by defining the physical, cultural and social aspects of the city of Annaba, which is at odds with its values, and determining its boundaries, even though it contains a highly archaeological site.

2. Material and Method

This work includes documentary research and visual analyzes (photos, maps and observations of major urban planners and architects in the field of urban identity). As part of the study, first, the identity of the city of Annaba is assessed as part of the historical development process. In the next step, visual analyzes were made using components of artificial environmental identity (roads, urban spaces, urban occupation, imaginary elements, landmarks, call points and plant patterns), which were revealed in the conceptual and theoretical framework of the study, in the envelope of the city of Annaba. Sources of visual analysis data are personal photographs taken in the study area, and maps.

Annaba and its Region: Knowledge of the Context:

Annaba is emerging as a modern city, in which leisure, entertainment, partying, going out (public life), far from being conditioned by specific times, or confined to places, generally spread almost daily. The emergence of the city of Annaba as a space recognized for its tourist possibilities, finds support precisely in what seems to distinguish it in a large environment, (urban walks and on the corniche, beaches, long coastline but especially the city). The latter happens to be the receptacle of desires for modernity long repressed by the sequences that the country has known.

Figure 1. General view of Annaba

The Geographical Setting:

The city Annaba is located in the eastern part of the Algerian coast, 600km from Algiers, it is built at the foot of the foothills of the Edough mountains, naturally sheltered against the winds from the North and the West, it imposes itself in its decoration bordered by the point of Ras-El-Haddid and the Cape Rosa, like a port with Mediterranean vocation, in more it animated by a beautiful road in ledge meadows of 15 km in the detours of which the cliffs alternate with small beaches with fine, golden and clear sand.

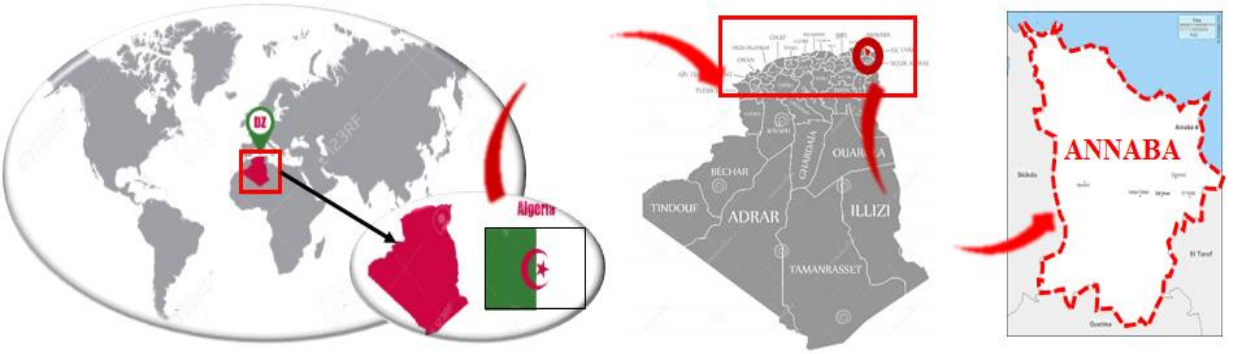


Figure 2. The situation of Annaba .Original (2021)

Annaba presents aspects of a modern city in full expansion because it constitutes an important industrial, university, and tourist center. It is geographically limited by:

- The Mediterranean in the North.
- The wilaya of Guelma in the South.
- The wilaya of El Taref in the east.
- The wilaya of Skikda in the west.

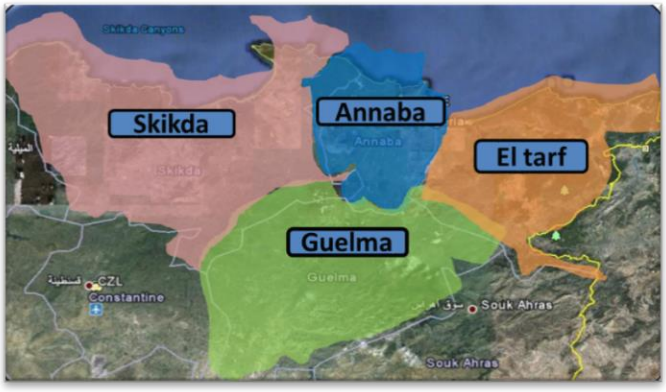


Figure 3. Geographic limits of Annba.

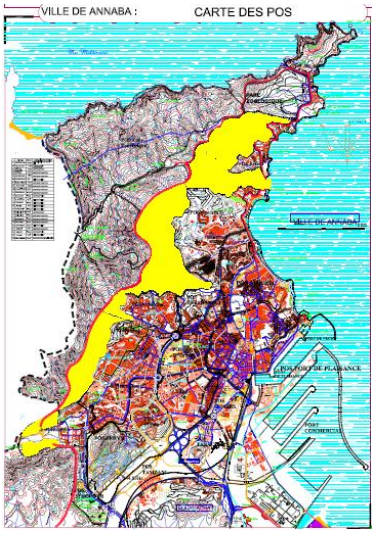


Figure 4. Annaba city map

Annaba, formerly Bône during the period of French colonization and Hippone in Antiquity, is the fourth city in Algeria after the capital Algiers, Oran and Constantine. It is located 152 km northeast of Constantine, and about 80 km west of the Tunisian border. It is also a coastal wilaya with a population of 640 050 inhabitants (RGPH 2015) [5].

On the natural level, Annaba is dominated by the mountain range of the Edough to the east, culminating at 1,008 m above sea level. Regarding hydrology, the Oued Seybouse joins the Mediterranean Sea from the mouth of Annaba [5].

Lake Fetzara is located in the west of the city, 14 km from the Mediterranean Sea. It stretches east west, 17 km long and 13 km wide. It is bounded to the north by the Edough massif, by the hills of Ain El Barda to the south and the dune ridges to the east and west. On the outskirts of the lake, there are several agglomerations: to the north, the capital of the municipality of Berrahal, to the south the territories of the municipalities of El Eulma (Oued El Hout) and Cheurfa and, to the east, the small villages El Gantra and Oued Zied.

3. Results and Discussion

Urban Identity Concept

In 1960's, the concept of identity appeared in the field of urban studies. As an example, Kevin Lynch (1960) mentioned that, the image of the city has three – always appearing together –components; identity, structure, and meaning. He considered the identity as "the identification of an object, which implies its distinction from other things, its recognition

as a separable entity [6]. It is not in the sense of equality with something else, but with the meaning of individuality or oneness" (p. 8) [6]. In addition, Lynch uses meaning as one of the component of the image of the city, he does not straightly point out the spatial meanings of the city for its residents. His definition of identity refers to the noticeable features of the city, while the term "structure" refers to the spatial relations of those features.

After Lynch, other researchers (e.g., Gordon Cullen, 1961; M.R.G. Conzen, 1966, 1975; Sharp 1969; and Roy Worskett, 1969) began to use the concept of spirit of place to the concept of identity of a place. They announced that, identity and/or character is thus closely linked with the form and the history of a place creating a sense of place [7].

Therefore, urban identity can be defined as the process of arranging and structuring all the representations that the various internal and external social groups of a city have of it, its past, its present and of its future, and this at a given moment in history.

J.-W. Lapierre completes this definition by shedding light on certain points: to him, identity designates "not only what makes the identity of a group, its difference from other groups, a singular set of specific characters, which signifies, symbolizes this unity and this difference, but also the constancy of this group in time, throughout history, despite all the changes that have affected it. Collective identity refers to the images by which the group recognizes a common past, remembers it, commemorates it, interprets and reinterprets it" [8].

Therefore, we can say that urban identity was shown to have a strong impact on residents' perceptions of urban quality. Moreover, it acts on their evaluation of existing and projected elements of their urban surroundings. Identity measures have to be taken into considiration in this context and may prove valuable as mediating variables in many areas of Environmental Psychology research.

Environmental Perception Concept

Environmental perception has generally been defined as awareness of, or feelings about, the environment, and as the act of understanding the environment by the senses. A more enveloping definition and theoretical framework was provided by psychologist William Ittelson (1973) who considered environmental perception as a multi-dimensional phenomenon, as a transactional process between the person and the environment. He provided three general conclusions about the nature of perceiving: first, it is not straightly controlled by the stimulus; secondly, it is associated to and indistinguishable from other aspects of psychological functioning; and thirdly, it is relevant and appropriate to specific environmental contexts. [9]

Environmental perception can also be defined as a concept of perception applied to individual and community relations with the environment. It is entertained as a psychosocial phenomenon, where the demonstration of the environment depends on cognitive and affectionate processes, constructing through individual experiences. The concept of environmental perception is multifaceted and linked to a socio-environmental perspective [9].

Among the ancient environmental perception studies were those of the physical structure of cities undertaken by Kevin Lynch at the Massachusetts Institute of Technology. Initiated in the 1950s, the objective was to identify salient perceived elements of the city and their contributions to urban legibility. Lynch, identified five principal features that defined urban images: paths, edges, districts, nodes, and landmarks. Lynch's work was replicated in cities around the world. It is still used by planners and designers in the analysis of existing conditions and in developing plans for the future [10].

Furthermore, the surrounding environment can convey symbolic meanings and can inspire, as well as provide opportunities for involvement. In addition, environments have an ambience – a quality, mood or atmosphere that can be associated to aesthetic attributes and to the social context within which the environment is experienced [10]. Moreover, the perception of any environment is influenced by an individual's experiences and current value orientations.

The Historical Context of Annaba City

The city of jujube has had, over the years, a privileged role in the history of the country thanks to its geographical location, which makes it a strategic link between two shores of the Mediterranean and to the diversity of cultural currents that there have taken root.

Annaba witnessed the passage of very great civilizations which marked its history and its experience and which left behind a heritage of remarkable richness, which constitutes a veritable open-air museum. Therefore, it is useful to recall

the civilizations that have found in Hippo as it was once called a fertile ground for their political, cultural and economic development [11-12].

The Prehistoric Period

The history of the first centuries of existence of a city in Annaba remains obscure; the vast gulf of the city and its region are particularly rich in prehistoric remains; its mild climate favorable to vegetation has always appeared to be a privileged region. The man has appeared in the Annaba perimeter since the Paleolithic era, in the area of Ras-Al-Hamra (Cap de Garde) and in the hills of Bouhamra [11-12].

Antiquity: Foundation of Hippo

Annaba is called Hippone (or hypo), the name also ubbon in Phoenician means shelter: refuge or even gulf. The site of the ancient Hippone is located in the plain of Annaba, enclosed between the two lower courses of the Oued Boudjema and its various branches to the North-West and the Oued Seybouse to the South-East.

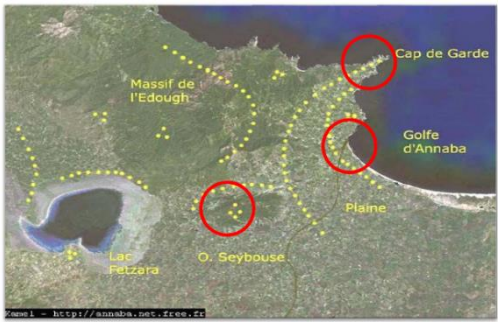


Figure 5. Annaba during antiquity

Foundation of Carthage - Punic Hippo

Among all the counters founded by the Phoenicians, there is one, which will prosper well beyond its metropolis; this is Carthage founded around -814 by Princess Tyrian Elissa, better known as Queen Dido.

The new republic of Carthage Nicknamed the empire of the sea, it dominated from the 7th century to the 4th century the maritime and commercial life of the western Mediterranean with its colonies of Sicily, Sardinia, Spain and the control of the old settlements. Phoenicians.

It will reach a high level of civilization and will be strongly illustrated by its wealth and independence, but from the 3rd century, Carthage loses control over the Hippone region following the Punic wars.

Figure 6. Monuments of the Punic civilization .

Numidian Kingdom - Punic Wars

Hippone lived very troubled times until the day when the fall of Carthage, in -146, gave him back his independence. The victory of Rome over Carthage therefore returned his throne to Massinissa. Thus, the proud city of Princess Elissa, founded more than 6 centuries previously, is definitely wiped off the map by Roman imperialism.

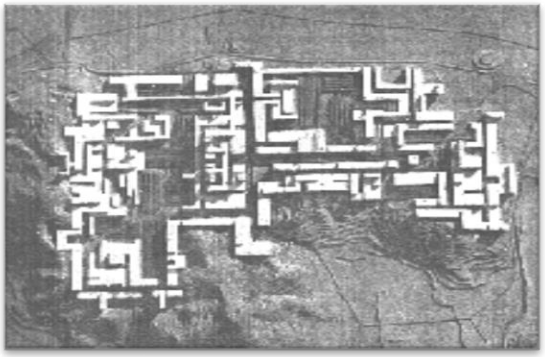


Figure 7. The model of Hippo la Royale.

Roman civilization

Two centuries later, the clashes between the Carthaginian and Roman empires on the one hand, and between the latter and the Numidian kingdom on the other hand, ended with the triumph of Roman expansion and the annexation of Hippo. Hippone becomes one of the largest centers of the new Roman province in Africa and will have as its first Latin governor, the historian Salluste. From then on, centuries of calm and prosperity will open for the city.

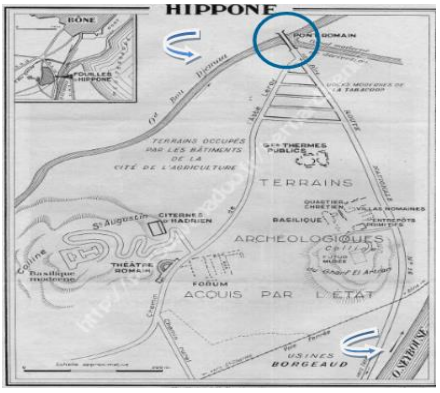


Figure 8. the city of Annaba during the Roman period .

The Arab conquest

Annaba and its regions remained outside the FETH period, until the arrival of the Arabs at the end of the 8th century.

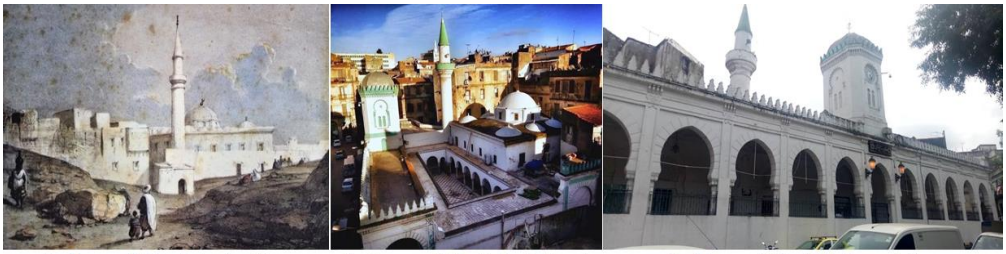
Foundation of Bouna El Haditha:

Islam appeared between 7th and 8th century and after the ruin of Hippo the Arabs founded another city on the hill of Abu Marouane which is called Bona El haditha; built on the side of santons, facing south down to the sea, was pierced by a door called "the sea door" facing east, towards the anchorage of the cazarins (Fabre), this anchorage was the most important, the most on and closest to town.

Figure 9. some monuments of the Arab period .

The Casbah was surrounded by walls of a quarter of a league turn, well built, and "all terraced the width of about two toises" surmounted by towers with speedboats advancing outside and placed at 15 or 20 paces from each other; the towers each had three, four or five pieces of cast iron cannon. There was only one door of war, a vast S-shaped corridor narrowing at the end "turned a little towards the city". There was a janissary post there with four small pieces of cannon. In the middle were houses and a mosque.

Figure 10. Bouna el haditha .



The Mosque of El Bey During the Ottoman Period , Source : https://www.annaba-patrimoine.com

The Mosque of El Bey During the French Period , Source : https://www.annaba-patrimoine.com

The Mosque of El Bey 2021. Source: Author

Figure 11: The alleys of the old Ottoman town . Original (2021)

The French conquest

Bouna was the second town to come under French assault, three weeks after the surrender of the dey of Algiers. Before the capture of Bône, the elements that made up the port: a landing stage located at the rocky outcrop known as pointe cigogne.

The year 1845 inaugurated the launch of the new French urban plan. In 1846, work began on Saint Augustine Cathedral, located at the time on the heights of the current Revolutionary Court. It was the first French building to be built outside the walls of the Arab city. Bone by its natural position, became the "gateway to the east", the point of concentration of troops, equipment and supplies [11-12].

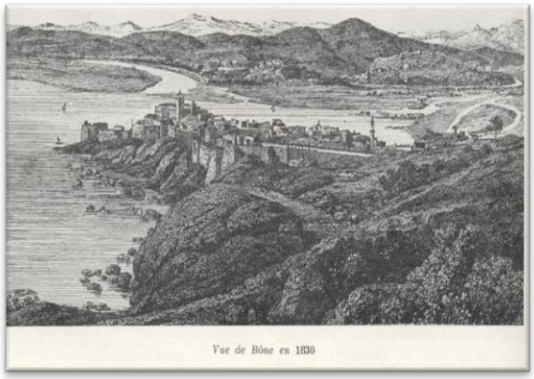


Figure 12 : View of Bône in 1830 .

Through this historical reading, in particular urban planning of the city of Annaba, we understand that its territory has experienced rapid development and a massive port establishment since the first half of the 20th century. A new urban configuration, which appears to bear several signs of growth and economic development as regards the port domain with the invasion of businesses and hangars in a large and sensitive part of the city, is however characterized by certain imbalances and dysfunctions, which appear in a logic of duality.

Figure 13. Some colonial monuments in Annaba

Social Relations and the Population of Annaba:

Families residing in the medina give the impression of living in social groups, without these groups being isolated or autonomous. Three scenarios presented themselves to us: the families who own their homes share very strong ties with a few neighbors, owners like them. Mutual knowledge is essential; it dates from the time of parents and grandparents. The uncles, aunts, parents and children of the different families in this group live in the same neighborhood space, each with its own entrance, but adjacency contributes greatly to the configuration and sustainability of this group. Domestic practices are organized, especially in the interior courtyard of one of the houses where the women meet; the front door is never closed. We find this sociability in the other two scenarios that of the family bond between the inhabitants of the house, and that of the total absence of family bond between the tenants of the house.

Despite the misunderstandings and conflicts that may exist, a strong solidarity remains between the different members of these groups, among themselves and with other groups in the medina. In these cases too, mutual knowledge is essential and the origins of this knowledge are belonging to the same family. The "elders" know each other and socialize; they are the "leftovers", those who did not benefit from social housing in the rehousing operations that the medina had experienced before. These references in seniority and in blood ties almost become a condition, an identity of township "Ouled* la Place d'Armes, the beldiyas" (i.e the townspeople), the "us, the elders" is opposed to them, the new ones".

Being an inhabitant of the old city means for the common people of Medina to be part of the "old". Among the references to this belonging, it is history or more exactly knowledge of its history. The stories of the inhabitants are often punctuated by this value that is the history of the old town, a relationship to the memory of the place, carried by temporal referents, such as the colonial period in which social life with Europeans was synonymous with mix and shared lifestyles.

Social ties, relationships with administrations, sociability, formal and informal social networks, everyday life, the various references to the belonging of the inhabitants play an active role in the social structuring and the formation of the identity of the city of Annaba. As a result, the Medinan space invents, reinvents itself, adjusts, appropriates, re-references, restructures, unites, disunites, brings together, opposes, constructs and occurs according to resources that the inhabitants mobilize [13].

Topographic and Visual Boundaries

The Topography of Annaba

The Edough massif flows into the Mediterranean on a North / East, South / West axis. It embraces the Annaba plain from the north.

The mount of the Seven Sleepers where the citadel and the mount of Saint-Augustin are located arises in isolated situation and stands out from the massif.

The coast to the north of the city is marked by a succession of spaces surrounded by the relief and the sea

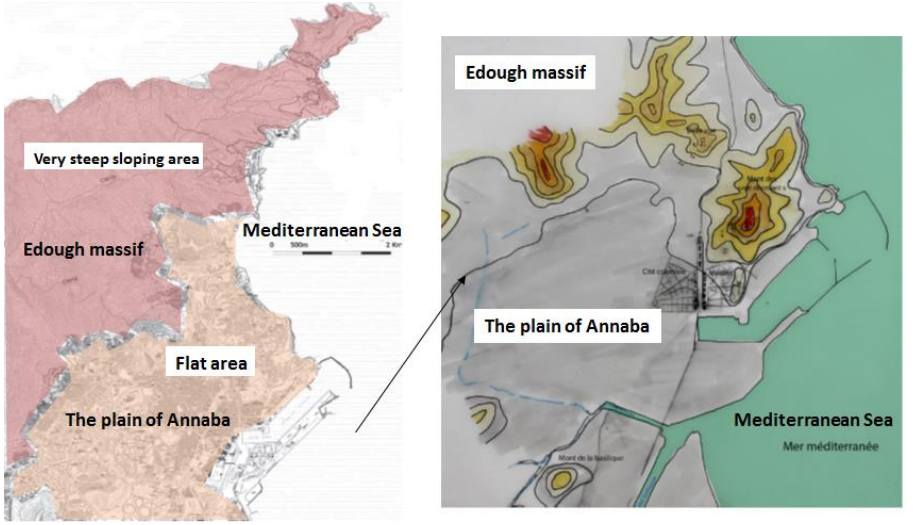


Figure 14. Topographic map of the city of annaba .Treatment : Author

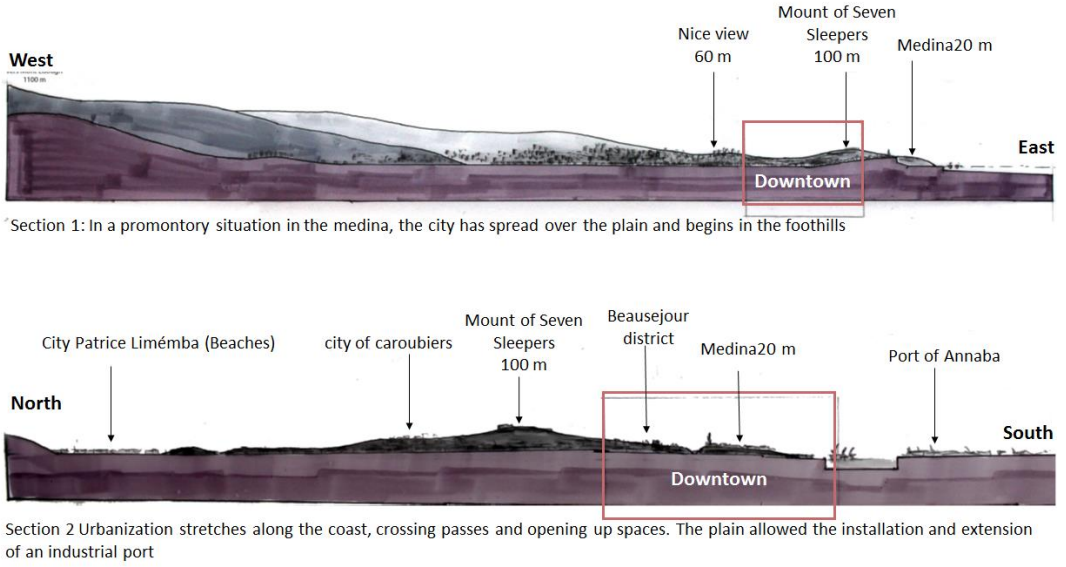


Figure 15 . Topographic section of the city of annaba. Treatment : Author

The Visual Limits of the City of Annaba

- **Vegetation and the City's Water Body**

- North-East_ More or less dense altitude vegetation bordering the city.
- On the coast_ Quality of a plant that contrasts with the sea.
- On steep slopes_ Dominance of spontaneous vegetation, that binds urban fabrics together.
- In the city_, large presence of parks, wooded massifs, gardens.

Given the topography of the city, the presence of the sea at the interior of the urban fabric is very restricted. The only visible panorama is on the promontoir of the medina, at the highest point.

Figure 16 . The plant fabric of the city of annaba . Original (2021)

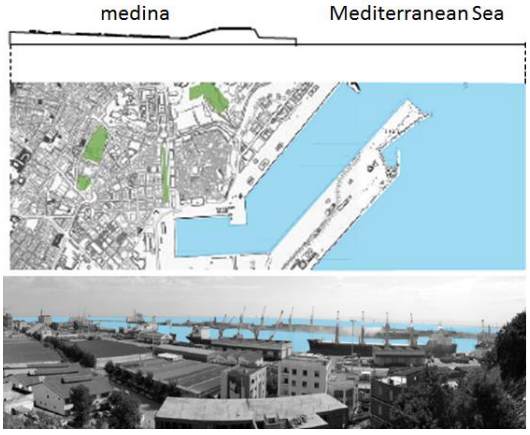


Figure 17. The City's Water Body.Original (2021)

- **Urban Facades**

The two facades were built at two different times. A first facade, hiding the medina, presents a homogeneity corresponding to a period dated from the second half of the 19th century. On the other hand, the second facade is heterogeneous and bears witness to the different periods of history ranging from the second half of the 19th to the second half of the 20th. The first colonial period is characterized by a collection of imported historical styles such as neo-Greek, neo-classical. The neoclassical finds itself grouped in a regular course forming a homogeneous and compact entity in the urban landscape of the city of Annaba; the colonial city center is a nice glimpse into the neoclassical style. This style

dresses the majority of official buildings of this period, as well as the buildings overlooking the public places, which convey the symbols glorifying the power of the French authority, in particular the town hall carried out in 1888 after four years of work. The main facade with the enormous decoration of pilasters, cornices, columns ... remains a model of neoclassical architecture. Neoclassical architecture as well in Annaba, as in many Algerian cities is a landscape component based on geometric shapes (parallelepipeds) with very remarkable decorative and structural elements in the exterior appearance of the buildings. To be harmonious, all the dimensions of a building had a basic modulus and a median axis of symmetry. Towards the middle of the 20th century, architectural and urban production in Algeria merges with that of France. Modern architecture is globalized, by the hands of French architects, and is spreading in all French cities and in those of its colonies. From now on, the urban fabric of the city of Annaba is made outside of the historical context. With a new layout and an image of modern architecture, it adapts to the evolution of architecture in the world: buildings that stand out for their height, and for their tinted facade and neglecting their aesthetic appearance [14].

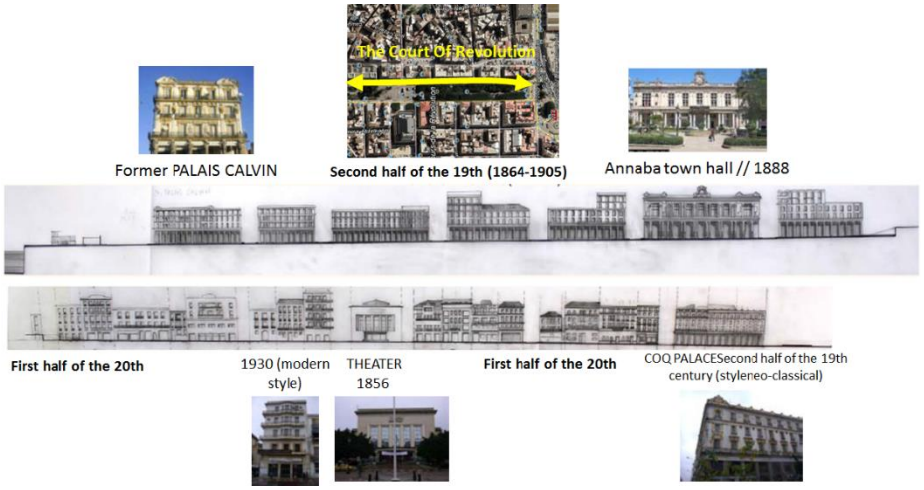


Figure 18 . Urban facade of the city center. Treatement : Author

The Boundaries and Landmarks Elements of the City

The boundaries (edges) are linear elements of the urban landscape, capable of being traversed visually and which constitute the edge of surface elements. These are natural or anthropogenic elements, which form real ruptures within the city: shores, railway trenches, walls, etc. The clearest boundaries are those which are strongly perceptible and which represent a continuous shape (even the boundary between the built front and the forest can help to structure the urban landscape when it is clearly defined). For it to be felt well in the landscape a limit does not have to be insurmountable; in fact, the boundary often acts as a seam that unites rather than a barrier that separates.

Landmarks are other specific elements of the urban landscape. Their nature can be very varied: a remarkable building, a singular plant element, a monument, a technical equipment, as the name suggests these elements allow the user to situate himself (at least in a relative way) and to orient oneself in the urban space.

Concerning the panoramic view of Annaba, it has a non-straight line of force, because of the variety at the level of the urban tessue, this variety comes from the different historical periods that this city has lived.

In the city one can find several landmarks of different nature, residential buildings such as the Belvedaire towers and the city of Kouba, facilities such as the Sybousse hotel, historical monuments such as the citadel and the cape de garde [15].

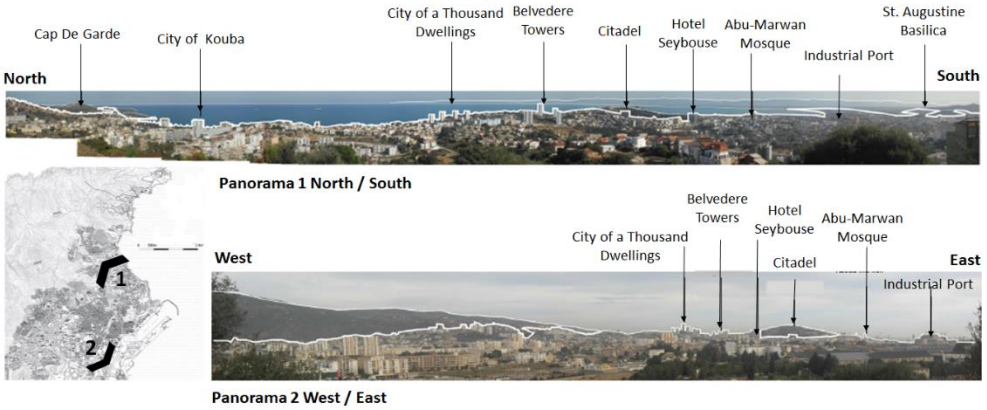


Figure 19. Line of Force and the Elements of Appeal of the City .Original (2021)

Built in 1300, **the Citadel** occupies a remarkable site in the city of Annaba, indeed from the top of the 109 meters of the mamelon on which it was built-the highest point on a radius of one kilometer , it also dominates the city to the south, the hinterland to the west and easy surveillance of the ledge to the north and the bay to the east.

The citadel is bounded by the Beauséjour district to the north-west, to the south facing the old town on the way to the aqueduct. It is bordered by the Chemin de l'Avant-Port to the east, and the Santons district to the west.

The site enjoys a strategic location as it is located high up in the heart of the city of Annaba, which allows it to have a breathtaking view of the city and its surroundings. It allows the articulation of the northern part to the southern part of the city center [16].

Figure 20. The citadel of Annaba 2017

Figure 21. The cap de garde of Annaba. Original (2021)

The Cap de Garde lighthouse, also called Ras Hamra lighthouse, is a landing light located a short distance north-west of the port of Annaba.

Cap de Garde closes the Gulf of Annaba to the northwest. A lighthouse was built in 1850 and from 1880 it underwent a first transformation and an extension with the installation of an optical system and a large lantern. The current lighthouse dates from 1908.

The lighthouse is built on the northwest slope of the cape. Square tower 17.5 m high, in exposed stone masonry topped with a lantern for internal maintenance, attached to a square building in smooth masonry with two guards' quarters and a room for passing staff. Nearby, to the southwest and west-southwest, two service buildings, square and rectangular, in smooth masonry, white. The lighthouse rises to 146.5 m above sea level. It is accessed by road [17].

4. Conclusion:

When the city of Annaba is assessed in terms of identity elements, we see that two natural elements of the environment have emerged as identity elements since the founding of the city. The first of these is the sea and green spaces, the second is the topographic structure formed by the hills and the Edough massif. Both elements are the most important factors in shaping the identity of the city of Annaba in the historical process. After the natural environment, the most important group of elements studied is that of the elements of human environmental identity.

Since its foundation, the city of Annaba has been a cosmopolitan social structure where different cultural groups live. Looking at the different cultural groups that settled here especially during the Ottoman and Colonial times which are the two great periods that marked the history of the city, we can see that they were composed of Muslims, Jews, d Armenians, Greeks and Europeans. If these groups settle on the coasts mainly near the port because of their professions or because of their relations with the West, the Muslim section generally settles inside [18].

These different cultures of the Ottoman period enriched the cultural identity of the city of Annaba. In the city, enriched by the economic and industrial breakthroughs and investments in industrial infrastructure during the period of the Republic, the demand for labor increased and there was a flow of people from various regions with internal migrations. New subcultures and new social identities appeared in the colonial period where large masses of population settled.

The city of Annaba, which has been studied from environmental perception approaches, is an open space with different natural forms. It shows visual continuity in its landscape with its natural peaks. Differences between architectural styles or styles of construction are strongly observed in the districts of the old town and the center of town. These neighborhoods stand out as a region with constructions with their own identity and the boundaries of the area are easily perceived.

In the city of Annaba, which has been examined in the historical process, it can be seen that the elements of identity and their importance within the city have changed over time. Annaba has a very different living environment today compared to past periods; It has lost much of its historical and aesthetic value. In addition to aging and wear and tear of historic monuments, the poor use of land applied in many sub-regions has deteriorated the natural structure. Insufficient and fragmented planning decisions in the region create a socially, economically and technically unhealthy environment. Annaba, with its historical and natural values, is a region that must be assessed in terms of tourism and urban service.

The identity transformation that took place in Annaba occurred due to changes in both the urban structure and the social structure during the Ottoman and colonial periods as well as the post-colonial period. This situation has ensured that Annaba has always had a strong identity in each era. We see that the identity of Annaba was formed by perceiving the natural, historical and cultural elements, each of which is a distinct element of identity, as a whole more effective than the meaning they carry alone[19].

In order to preserve these values of the city of Annaba and ensure its continuity, it is necessary to ensure that the city and its surroundings are kept alive. For this, first of all, Annaba is defined as an archaeological value with its natural, historical, cultural and functional identity elements, such as a mosaic of settlement, a port, an industrial zone and a cosmopolitan urban environment where many cultures live.

This region should be able to develop as a tourist, cultural, artistic and commercial center. When defining these functions, the hydrous and topographical characteristics of Annaba, which are the elements of natural identity, must always be taken into account [20]. Considering the water element in the historical process, it can be seen that the port has always been used as a means of transport for industry. With the evaluation of this element in the planning studies, it will be an application that will increase the importance of the city of Annaba, which presents different views every hour of the day, in terms of tourism.

The management of Annaba from a tourist point of view is of particular importance for Algeria. It is necessary to clean up the settlements on the hills that create the topographical boundary in a way that emphasizes the historical and cultural identity, and to determine the conditions that will not allow the construction to disrupt the silhouette. The management of Annaba with a holistic approach is of great importance for the city, which will become an important center for all of Algeria and why not for Africa as a cultural asset in the future.

Competing Interest / Conflict of Interest

The authors declare that they no conflict of interest. None of the authors have any competing interests in the manuscript.

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Adequacy and Accessibility Analysis of Open and Green Spaces in Osmaniye Center

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ABSTRACT

The scarcity of open and green spaces, which should be an integral part of the urban fabric and urban planning, is not a big metropolitan city problem in Turkey anymore but is a challenging problem of even medium and small-sized cities, one of which is the Osmaniye city today. This study examined the neighborhood-level quantitative adequacy and accessibility of the current and future open and green spaces in Osmaniye city center. The analyses were performed using ArcGIS 10.0 software following the Spatial Plans Construction Regulation. Accordingly, it was found that there were 48 open and green spaces with an area of 278566.33 m^2 in the Osmaniye city center, which had 1.15 m^2 open and green spaces per person. It was concluded that no neighborhood had enough open and green space. Children playgrounds were the fewest open and green spaces in the research area, and more than half of Osmaniye city center lacked access to children playground. Therefore, suggestions were made to solve the open and green spaces' unavailability and access problems in neighborhoods considering the study results.

Anahtar Kelimeler:
Erişebilirlik,
Yeterlilik,
Açık ve yeşil alanlar,
Osmaniye kenti,
Kentsel planlama.

ÖZ

Kentsel dokunun ve kent planlamasının vazgeçilmez unsuru olması gereken açık ve yeşil alanların yetersizliği, ülkemizde sadece büyük metropol kentlerin sorunu olmaktan çıkıp günümüzde orta ve küçük ölçekli kentlerde bile hissedilir hale gelmiştir. Bu kentlerden biri de Osmaniye kentidir. Bu çalışmada Osmaniye kent merkezindeki mevcut ve planlanan açık yeşil alanların mahalle düzeyinde nicel yeterliliği ve erişilebilirliği analiz edilmiştir. Analizler ArcGIS 10.0 bilgisayar yazılımı kullanarak Mekansal Planlar Yapım Yönetmeliği'ndeki sınıflandırmaya göre gerçekleştirilmiştir. Çalışmanın sonucunda Osmaniye kent merkezinde 278566.33m^2'lik alana sahip 48 adet açık ve yeşil alan olduğu ve kişi başına 1.15 m^2 açık yeşil alan düştüğü belirlenmiştir. Mahalleler düzeyinde ise hiçbir mahallenin yeterli açık ve yeşil alana sahip olmadığı tespit edilmiştir. Araştırma alanında erişim yoksunluğu en fazla olan açık yeşil alan sınıfı çocuk parklarıdır. Osmaniye kent merkezinin yarısından fazlasının çocuk parkı erişiminden yoksun olduğu saptanmıştır. Bu kapsamda çalışmanın sonucunda açık ve yeşil alan yoksunluğu ve erişim sorunu yaşanan mahalleler için öneriler geliştirilmiştir.

1. Introduction

In the late 18th century, the Industrial Revolution led to massive population movements from rural areas to industrial zones around small urban centers. During this period, the requirements for housing, recreation, infrastructure, and transportation systems increased, which created modern urban planning [1]. It can be suggested that the initial attempt of modern urban planning was to balance between the buildings and open and green spaces in cities. However, open and green spaces have been neglected in the urban planning of the countries that could not effectively integrate environmental policies into other sectoral policies. As Gül and Küçük (2001) stated, the identity of a city is not defined only by its urban composition but also by the relations between the architectural structures and open and green spaces [2]. In this sense, urban open and green spaces are critical for providing urban comfort with ecological, economic, and social functions.

Ecologically, open and green spaces reduce air and noise pollution, contribute to the treatment of ground and surface waters, prevent floods by controlling the surface flow and heat islands, which is one of the most critical problems in urban areas, by tempering the climate [3-5]. Economically, open and green spaces are tourist attractions that contribute to investment and employment opportunities in cities and increase land values [6-9]. They also provide several social benefits to the residents of densely built and populated urban areas detached from nature. They contribute to urban residents' social and cultural development and health by offering recreational grounds and sports facilities with aesthetic values [6, 8, 10]. According to Manavoğlu and Ortaçeşme (2015), open and green spaces also ensure a balanced integration and organization of all other spatial units regarding occupancy and land use in cities [11]. In urban planning, the qualitative and quantitative parameters such as the number, size, accessibility, distribution, and equipment should be considered to take advantage of open and green spaces for the urban ecosystem [11, 12]. Each country establishes open and green space systems following its urban planning legislation and administrative procedures.

The primary urban planning legislation in Turkey is the development plan law. The open and green spaces in the laws and regulations are determined per person (m^2). The legislation on the use of open and green spaces has not changed in the Spatial Plans Construction Regulation, published in the Official Gazette of 14.06.2014 (No: 29030), and is still in force. Accordingly, the amount of open and green space per person is a minimum of 10 m^2. Annex-2 of the regulation has been amended with the regulation published in the Official Gazette of 17.05.2017 (No: 30069).

The amendment was about the classification of open and green spaces and the area per person. In cities as level of district the child playground, park, square, sports field, botanical park, and recreational grounds should be planned 10 m^2/per person. Addition to this amount 5 m^2/per person zoo, urban forest, afforested area, hippodrome, and fair and festival areas should be planned in city level. However, many studies show that the open and green spaces in cities are below the standard in Turkey [11-21].

The scarcity of open and green spaces, which should be an integral part of the urban fabric and urban planning, is not a big metropolitan city problem in Turkey anymore but is a challenging problem of even medium and small-sized cities. As the 80th province of Turkey, Osmaniye is one of those cities. Osmaniye was one of the districts of Adana until it became a province in 1996, which was a breaking point in population growth and city planning of Osmaniye. Multi-story residences have replaced single or double-story detached houses with gardens. The increasing population has highlighted the need for open and green spaces.

Nevertheless, as Ergan (2011) stated, a decline in open and green spaces has been observed in Osmaniye province since the zoning plan of 1987 [16]. Especially the precedent principle adopted in 2017 has worsened this problem. The precedent principle refers that as the parcel area increases, the construction rights such as precedent and maximum height expand, and theoretically aims to control the balance between open spaces and housing by allowing the houses with gardens. However, in practical terms, it has created densely built and populated areas. This situation has led to a decline in the amount and quality of open and green spaces per person, especially in the city center. The precedent principle, which has been in force since 2017, has required the re-organization of the open and green spaces in Osmaniye.

According to the current legal regulations, this study aimed to evaluate the size, per capita amount, neighborhood-level distribution, and accessibility of open and green spaces in Osmaniye city center. The open and green spaces in the development plans were also discussed in the study, and necessary suggestions were made accordingly.

2. Material and Method

The central district of Osmaniye was the primary study area. Located in the east of the Mediterranean Region, Osmaniye is on the transition road between the east and west of Turkey. The Central Taurus Mountains surround Osmaniye from west to north and the Amanos Mountains from east to southeast. Osmaniye is the neighbor of Gaziantep in the east, Hatay in the south, Adana in the west, and Kahramanmaraş in the north. It has seven districts: Bahçe, Düziçi, Hasanbeyli, Kadirli, Sumbas, Toprakkale, and Central district (Osmaniye), chosen as the primary research area due to its densest population and the fastest urbanization rate (Figure 1).

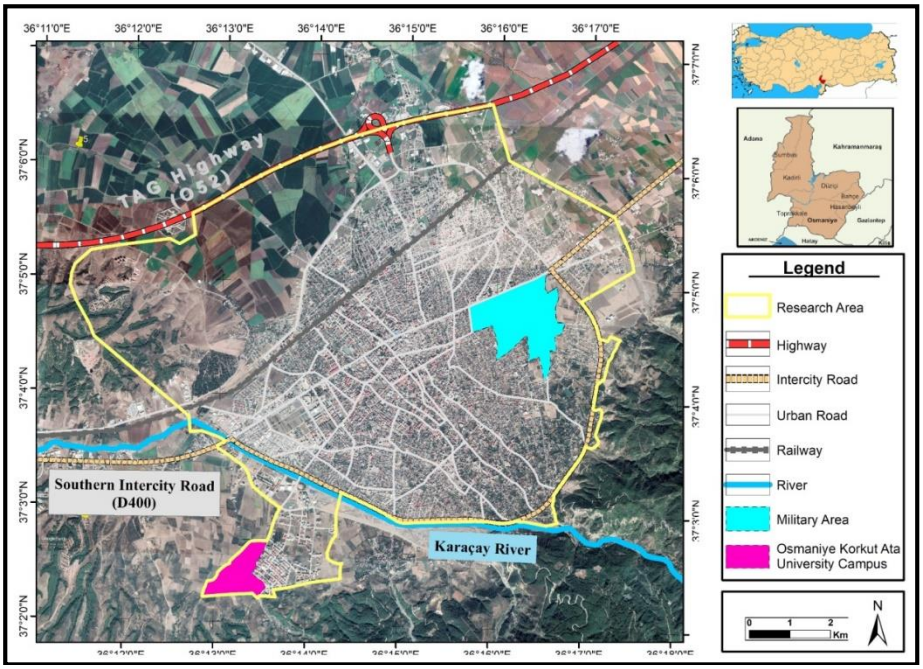

Figure 1. Location of the study area.

There are four main stages and substages in the study. In the first stage of the study, information about the population size and density in the neighborhoods of Osmaniye was obtained from the Turkish Statistical Institute to determine the adequacy of the available open and green spaces in the city center [22]. The neighborhood-level population density was mapped using ArcGIS software, and neighborhoods were classified according to the population density. In the second stage, the open and green spaces in Osmaniye city center were categorized according to the Spatial Plans Construction Regulation-Annex-2 (Table 1).

Table 1. Standards and minimum area sizes for open and green spaces in different population groups [23]

Spatial Plans Construction Regulation Annex-2			population groups per person m^2			
			0- 75000	75001-150000	150001-500000	501000-+
open and green spaces	Planning within the district boundaries	Child playground	10.00	10.00	10.00	10.00
		Park				
		Square				
		District sports field				
		Botanical park				
		Promenade				
		Recreation				

The classification process was done in ArcGIS 10 software using Google Earth satellite images, field studies, and development plans retrieved from Osmaniye Municipality. The distribution and per capita amount of open and green spaces in Osmaniye city center were determined at the neighborhood level. Urban forests, cemeteries, city parks, and refuges/safety islands, which are not included in the regulation but acknowledged as urban green spaces in the literature, were also added to the calculation, and a separate calculation was performed to determine the open and green space per capita in the city center. The results were compared with the minimum values ($10m^2$ /person) in the Spatial Plans Construction Regulation-Annex-2, and open and green spaces per capita in the study area were determined at the neighborhood level. Then, the future open and green spaces planned for Osmaniye city center in the development plan amendment 2017 were revised.

In the third stage, the accessibility (service area) of children playgrounds, neighborhood parks, and sports fields, commonly used open and green spaces by city dwellers, were analyzed. Buffer areas, which determine the optimal transportation distance, were created using ArcGIS 10 software. According to the Spatial Plans Construction Regulation (Article 12) playgrounds and sports fields should be planned within 500 m service area. But according to many studies such as Ersoy (2007), Uz (2005), Altunkasa (2004), Oh and Jeong (2007), Kellett and Matthew (2009), Duncan et al., (2011), the optimum service area for neighborhood parks is 800 m [1, 10, 24-28]. Similarly, Van Herzele and Wiedemann (2003) state that it is 400 m for the playground and recreational areas at the neighborhood level, and 800 m at the district level [29]. In this study, the optimum service area was determined 400 m (10-minute walk) for children playgrounds and 800 m (approximately 20-minute walk) for neighborhood parks and sports fields. At the last stage of the study, the past and present sufficiency and accessibility of open and green spaces in Osmaniye were discussed, and particular suggestions were made for the current situation and future planning at the neighborhood level. Accordingly, it was suggested to prioritize the open and green spaces in urban planning, which was calculated as the minimum 10 m^2 open green area per person at the neighborhood level in the given regulation.

3. Results

3.1. Population Density in Osmaniye City Center

According to TÜİK (2020), Osmaniye's population is 243490 living in 36 neighborhoods [22], and the area is 4303.81 hectares. According to the population density measurements, the research area's most densely populated (more than 200 ha/person) neighborhoods are Mehmet Akif Ersoy and Raufbey neighborhoods (Figure 2).

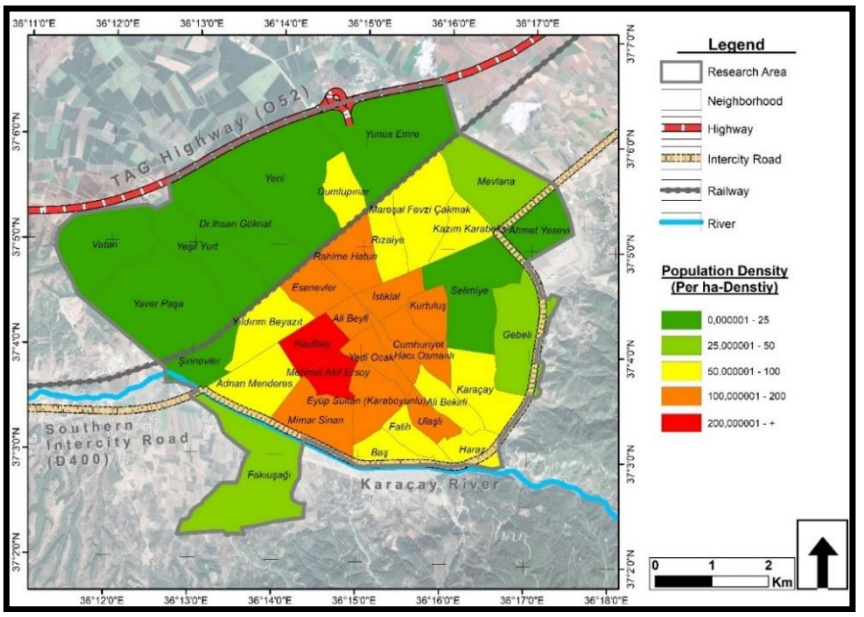

Figure 2. Population density map of Osmaniye district

The population density of 11 neighborhoods around the given two neighborhoods is more than 100 ha/person. Neighborhoods with low population density are generally in the west of the railway line, where single or two-story buildings are widespread.

3.2. The Available and Future Open and Green Spaces in Osmaniye City Center

There are children playgrounds, neighborhood parks, squares, and sports fields in the Osmaniye city center, among the open and green spaces categorized in the Spatial Plans Construction Regulation. The distribution of those spaces in Osmaniye city center was determined in Figure 3.

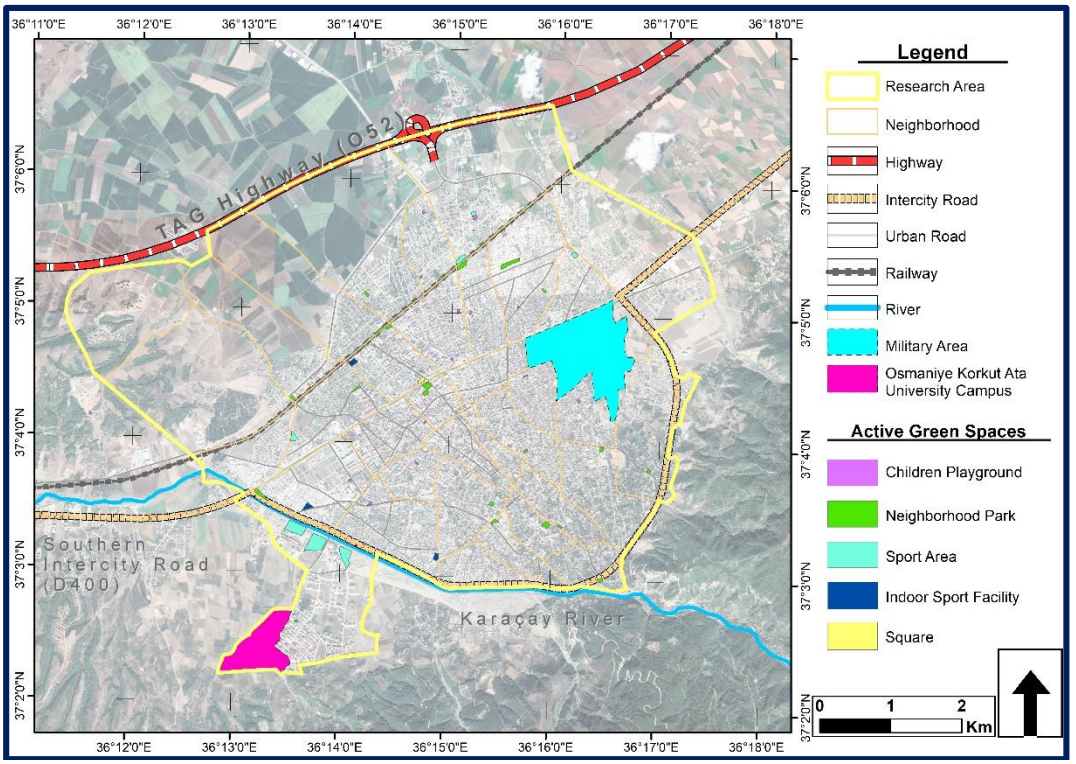

Figure 3. Distribution of open and green areas in Osmaniye district

According to the study results, there were 48 open and green spaces in the city center of Osmaniye, including 15 children playgrounds, 20 neighborhood parks, 12 sports fields/facilities, and 1 square, and they covered a total area of 278566.33 m^2. The amount of open and green space per person was 1.15 m^2 in the research area, which is well below the minimum value of 10 m^2 in the Spatial Plans Construction Regulation. In addition to the spaces specified in the regulation, there were also a "Masal Park" thematic park (33414 m^2), cemetery (519700 m^2), military area (1318800 m^2), refuges/safety islands (38800 m^2), Osmaniye Korkut Ata University campus (330000 m^2), and forest area (23000 m^2). The forest area is only categorized as an open and green space in the mentioned regulation, while other spaces are not. In addition, these areas are not suitable for active use by the public as open and green spaces. However, a second measurement was made, including the given spaces due to their benefits to the city residents. The results showed that the amount of open and green spaces available in Osmaniye city center was 2542280.33 m^2 and 10.44 m^2 per person. According to the distribution of open and green spaces at the neighborhood level, 36 neighborhoods had 12 children playgrounds, 18 had neighborhood parks, and nine had sports fields. There were no open and green spaces in 9 neighborhoods (Table 2).

Table 2. Open and green areas in the study area according to Spatial Plans Construction Regulations

Neighborhood		children playground	Neighborhood Park	Sports Field and Facility	Square	Total Area	Ratio to Neighborhood Area %	m^2/person
Adnan Menderes	Number	1	1	1	-	3	1.48	2.22
	Area (m^2)	1484.07	8603.45	7811.31	-	17898.83		
Ahmet Yesevi	Number	-	-	-	-	-	0.00	0.00
	Area (m^2)	-	-	-	-	-		
Ali Bekirli	Number	-	1	-	-	1	0.35	0.39
	Area (m^2)	-	2012.31	-	-	2012.31		
Alibeyli	Number	-	2	-	-	2	3.20	2.44
	Area (m^2)	-	11369.83	-	-	11369.83		
Baş	Number	-	-	-	-	-	0.00	0.00
	Area (m^2)	-	-	-	-	-		
Cumhuriyet	Number	-	1	-	-	1	0.22	0.17
	Area (m^2)	-	1584.95	-	-	1584.95		
Dr.İhsan Göknal	Number	-	1	-	-	1	0.16	1.05
	Area (m^2)	-	3359.68	-	-	3359.68		
Dumlupınar	Number	2	-	-	-	2	0.47	0.77
	Area (m^2)	3045.97	-	-	-	3045.97		
Esenevler	Number	1	1	1	1	4	2.30	1.94
	Area (m^2)	1095.98	3056.27	7330.76	6010.00	17493.00		
Eyüp Sultan	Number	-	1	1	-	2	0.60	0.48
	Area (m^2)	-	3106.45	2217.74	-	5324.19		
Fakıuşağı	Number	**-**	**1**	**3**	-	**4**	**4.04**	**9.51**
	Area (m^2)	**-**	**1593.50**	**113780.25**	-	**115373.75**		
Fatih	Number	-	1	-	-	1	0.75	1.03
	Area (m^2)	-	3652.87	-	-	3652.87		
Gebeli	Number	-	1	-	-	1	0.13	0.39
	Area (m^2)	-	2265.21	-	-	2265.21		
Hacı Osmanlı	Number	-	-	-	-	-	0.00	0.00
	Area (m^2)	-	-	-	-	-		
Haraz	Number	-	1	1	-	2	0.75	1.45
	Area (m^2)	-	2931.65	1365.55	-	4297.2		
İstiklal	Number	-	-	-	-	-	0.00	0.00
	Area (m^2)	-	-	-	-	-		
Karacay	Number	-	1	-	-	1	0.30	0.48
	Area (m^2)	-	3383.16	-	-	3383.16		
Kazım Karabekir	Number	-	-	1	-	1	0.77	0.93
	Area (m^2)	-	-	5020.98	-	5020.98		
Kurtuluş	Number	1	-	-	-	1	0.20	0.15
	Area (m^2)	1017.88	-	-	-	1017.88		
Mehmet Akif Ersoy	Number	1	-		-	1	0.21	0.07
	Area (m^2)	1028.94	-	-	-	1028.94		
M. Fevzi Çakmak	Number	1	2	-	-	3	1.06	1.09
	Area (m^2)	577.78	14909.90	-	-	15487.68		
Mevlana	Number	-	-	-	-	-	0.00	0.00
	Area (m^2)	-	-	-	-	-		
Mimar Sinan	Number	1	-	1	-	2	0.68	0.58
	Area (m^2)	2059.82	-	6175.39	-	8235.21		
Rahime Hatun	Number	2	-	-	-	2	0.27	0.19

	Area (m^2)	2547.34	-	-	-	2547.34		
Raufbey	Number	1	-	-	-	1	0.12	0.06
	Area (m^2)	875.40	-	-	-	875.40		
Rızaiye	Number	1	1	-	-	2	1.39	1.52
	Area (m^2)	1419.13	8394.28	-	-	9813.41		
Selimiye	Number	1	-	-	-	1	0.08	0.41
	Area (m^2)	1776.13	-	-	-	1776.13		
Şirinevler	Number	-	-	-	-	-	0.00	0.00
	Area (m^2)	-	-	-	-	-		
Ulaşlı	Number	-	1	-	-	1	1.38	1.35
	Area (m^2)	-	6283.88	-	-	6283.88		
Vatan	Number	-	-	-	-	-	0.00	0.00
	Area (m^2)	-	-	-	-	-		
Yaverpaşa	Number	-	-	-	-	-	0.00	0.00
	Area (m^2)	-	-	-	-	-		
Yedi Ocak	Number	-	-	-	-	-	0.00	0.00
	Area (m^2)	-	-	-	-	-		
Yeni	Number	-	1	-	-	1	0.09	0.73
	Area (m^2)	-	3119.72	-	-	3119.72		
Yeşil Yurt	Number	-	1	-	-	1	0.17	0.92
	Area (m^2)	-	2814.11	-	-	2814.11		
Yıldırım Beyazıt	Number	-	1	1	-	2	1.20	1.67
	Area (m^2)	-	3299.75	9316.15	-	12615.9		
Yunus Emre	Number	2	-	2	-	4	0.54	2.67
	Area (m^2)	3622.30	-	13246.51	-	16868.81		
TOTAL	Number	**15**	**20**	**12**	**1**	**48**	**0.63**	**1.15**
	Area (m^2)	**20550.74**	**85740.95**	**166264.64**	**6010.00**	**278566.33**		

Among the neighborhoods with open and green spaces, Fakıuşağı neighborhood had the most considerable amount of open and green spaces per person. However, it was still below the minimum value of 10 m^2 per person as specified in the regulation. In the revised development plan approved by Osmaniye Municipality Council on 06.01.2017, the recommended amount of open and green spaces is 489008 m^2. If the recommendations are followed, the total amount of open and green spaces in Osmaniye city center will be 767574.33 m^2, and the per capita amount will be 3.15 m^2. However, it is still below the minimum value in the regulation.

According to the distribution of planned open and green spaces at the neighborhood level, no open and green space construction is planned for Mehmet Akif Ersoy and Raufbey Neighborhoods, which currently have the least open and green space per capita. Additionally, no neighborhood park and children playground construction are planned for the nine neighborhoods that do not have open and green spaces. It is only planned to build one sports field in Baş, Ahmet Yesevi, and Yaverpaşa Neighborhoods (Figure 4). Yedi Ocak, Vatan, Şirinevler, Mevlana, İstiklal, and Hacıosmanlı Neighborhoods, which lack open and green spaces, were not included in the open and green space planning in the 2017 revised development plan.

On the other hand, according to the 2017 revised development plan, the future amount of open and green space per person in the neighborhoods increased significantly. For example, it is planned to increase the current open and green space of 9.51 m^2 to 10.98 m^2 per person in the Fakıuşağı Neighborhood, which thus will become the only neighborhood in Osmaniye city center that meets the minimum value in the regulation.

According to the 2017 revised development plan, the new open and green areas do not meet the needs of the city dwellers due to the high population and urbanization rate. Approximately 1670000 m^2 of open green spaces are required in the city center to meet the minimum value specified in the regulation (Table 3).

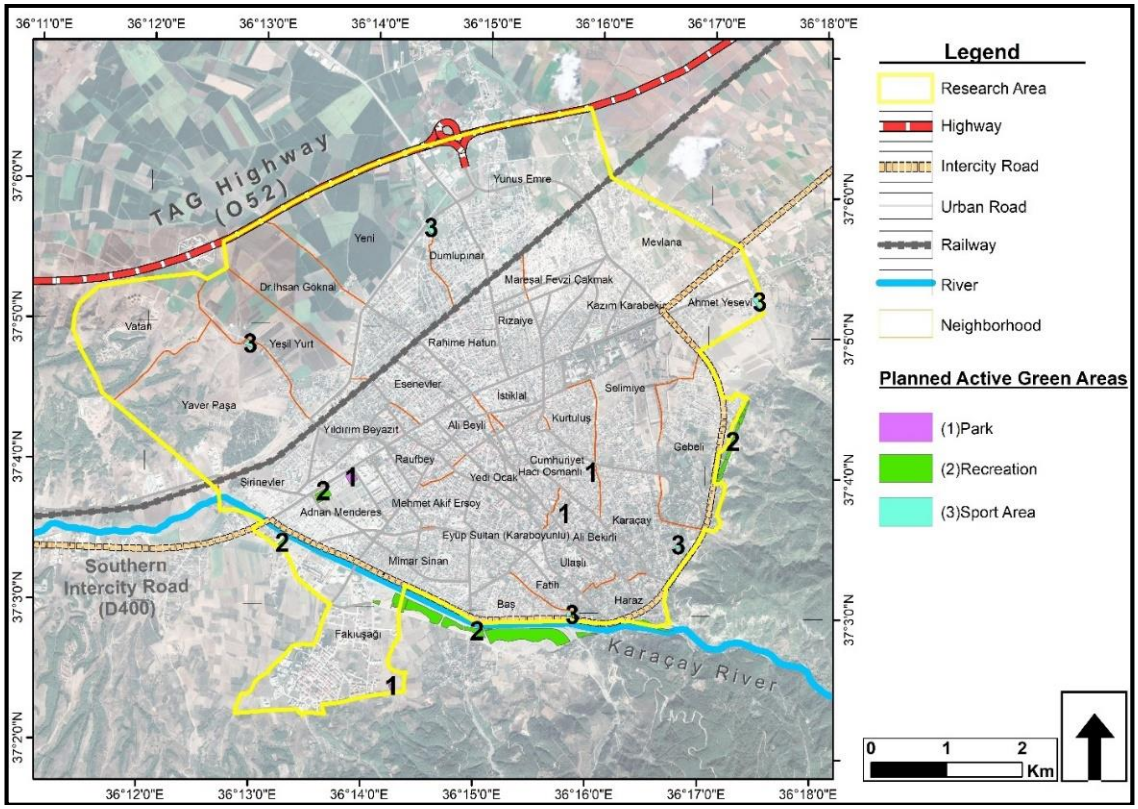

Figure 4. Open and green areas envisaged in Osmaniye City Center 2017 Revision Development Plan

Table 3. Evaluation of existing and planned open green space areas within the scope of Spatial Plans Construction Regulation

	existing and planned open green space	With the 2017 Revision Contraction Plan	The area that should be according to the minimum value of the regulation	Required open green space
Area (m^2)	278566.33	767574.33	2434900	-1667325.67
m^2/person	1.15	3.15	10.00	-6.84

Besides, Osmaniye Governorship (2020) plans to build a National Garden on the land of the General Directorate of Forestry next to the Theme Park in the Osmaniye city center [30]. Although the spatial size of the National Garden is not known, it will increase the total amount of open and green spaces in Osmaniye city center.

3.3. Accessibility of Open and Green Spaces in Osmaniye City Center

The inadequacy and unbalanced distribution of open and green spaces in the Osmaniye city center required analyzing the accessibility to those spaces (Figure 5).

The analysis results revealed that 16.52% (7108070 m^2) of the research area was children playground, 51.60% (22209831.19 m^2) was neighborhood parks, and 46.22% (19887732.44 m^2) was sports fields/facilities. Most of the children playgrounds were in the center of the research area. Approximately 80% of the neighborhoods in Osmaniye city center lacked children playgrounds. Especially the distance of the closest children playgrounds in the periphery neighborhoods can be up to 2000 m. Neighborhood parks were more accessible than children playgrounds due to the

higher number of neighborhood parks and their distribution within the area. The neighborhood park accessibility distance (service area) was measured at 800 m 52% of the research areas at the neighborhood level were the neighborhood parks. The most disadvantaged neighborhoods in accessing the neighborhood parks were Vatan, Mevlana, Mimar Sinan, Selimiye, Mehmet Akif Ersoy, and Raufbey neighborhoods.

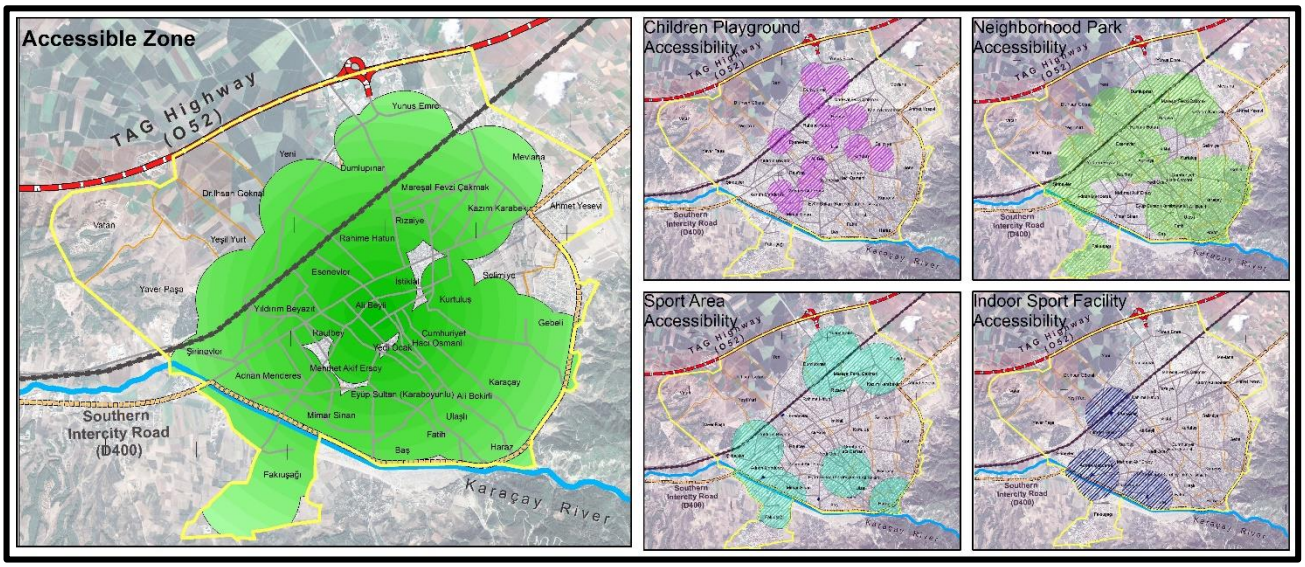

Figure 5. Accessibility of green areas in Osmaniye district

When the sports field and facilities were discussed in terms of accessibility, it was found that 33% of the neighborhood area was sports fields, and 14% were sports facilities. There was a sports field or sports facility in about half of the research area (47%). However, their distribution was quite uneven. They were primarily located in the south and north periphery neighborhoods, and all the neighborhoods in the center were out of the sports fields' service area. When the accessibility to open and green spaces in Osmaniye city center was addressed in general, it was found that 67% of the research area was within the service area of open and green spaces. Furthermore, the neighborhoods that did not have much access to open and green spaces were Selimiye, Ahmet Yesevi, Yaverpaşa, Yeşil Yurt, Dr. İhsan Göknal, and Yunus Emre Neighborhoods. The Vatan Neighborhood did not have any open and green space.

4. Discussion

Open and green spaces with ecological, economic, and social benefits provide livable and comfortable environments to city dwellers. According to Manavoğlu and Ortaçeşme (2005), a systematic planning framework, from macro to micro scale, is necessary to provide the multifaceted benefits of open and green spaces to the urban ecosystem and residents [11]. Gül and Küçük (2001) stated that open and green space planning should be done by considering the physical structure and all components of a city, including the physical and mental needs of city residents [2]. However, as Hepcan (2013) stressed, open and green spaces are constructed randomly in Turkey, rather than adopting an approach that considers the needs of the city and residents and natural landscape, which leads to the inadequacy and unbalanced distribution of open and green space in cities [31] The results of this study also revealed the shortcomings caused by the lack of a systematic approach to open and green spaces in the city of Osmaniye (Table 4).

Table 4. Comparison of case studies on open and green spaces in various cities with the result of this study

Study	City	Green Area Per Person m²	Open and green space classification
[32]	Antalya	4.4	active green space
[13]	Kayseri	5.4	active green space
[15]	Kahramanmaraş	1.4	Children playground, park and sports field
[16]	Osmaniye	0.4	Neighborhood park, children playground, sports field
[17]	Burdur	4.0	children playground, sports field
[11]	Antalya	4.2	active green space
[18]	Kırklareli	1.6	Children playground, park and sports field
[20]	Niğde	4.0	Children playground, park and sports field
[33]	Konya/ Selçuklu	12.53	Neighborhood park, children playground, urban forest
[34]	Nevşehir	3.30	Active green space
[35]	Çanakkale	3.05	Active green space
Results of this study	Osmaniye	1.15	Children playground, park and sports field
		10.44	Children playground, park and sports field, refuge, cemetery, urban forest, thematic park, university campus

The open and green spaces per person in many cities of Turkey are far below the minimum value in the Spatial Plans Construction Regulation. One of them is Osmaniye district. However, when the categories of open and green spaces in Annex -2 of the Regulation (district boundaries) are taken into account, the amount of open and green spaces per capita in Osmaniye remain quite low compared to many studies listed in Table 4. The amount of open and green space per capita in Osmaniye is significantly higher compared to other studies when not only the Regulation categories but also all open and green space categories are taken into account.

5. Conclusion

Rapid population growth, multi-story buildings, and unplanned urbanization cause several social, economic, and environmental problems in Osmaniye. This situation negatively affects the life quality of urban residents. The new open green areas do not meet the needs of the Osmaniye city dwellers due to the high population and urbanization rate. After Osmaniye became a province in 1996, the city population increased rapidly. The settlement previously consisted of single or double-story houses with orchards, but multi-story buildings have replaced them. The precedent principle in the revised zoning plan 2017 also triggered the population growth, making the need for open and green spaces more evident. However, the available open and green spaces in Osmaniye city center were not compatible with the population growth.

There is an urgent need for new open and green spaces for both legal regulations and urban residents. The locations of the new open and green spaces should be determined considering the requirements at the neighborhood level. The available open and green spaces in all neighborhoods in Osmaniye city center are below the minimum value in the regulation. Out of 36 neighborhoods, nine do not have any open and green space. The low amount of open and green spaces per person and the unavailability of open and green spaces in 9 neighborhoods underline the importance of accessibility. Especially Vatan and Ahmet Yesevi Neighborhoods did not have any open and green spaces or any access to close green space. Thus, it can be inferred that these neighborhoods were in the most disadvantaged position, and they should be prioritized for providing open and green spaces. There is an urgent need for open and green spaces in those neighborhoods. However, there has been no realistic or practical submission and offer for the number and spatial size of open and green spaces in neighborhoods so far, especially in the neighborhoods in the south of the railway, as those neighborhoods had multi-story buildings and dense populations. They also did not have enough space for the planned open and green spaces. Therefore, the planned open and green spaces in Osmaniye city center were listed to prioritize the open and green space category and accessibility.

The neighborhoods that have few open and green spaces in Osmaniye city center were Vatan, Ahmet Yesevi, Yaverpaşa, Şirinevler, Mevlana, Baş, İstiklal, Hacı Osmanlı and Yedi Ocak neighborhoods. Except for the Vatan Neighborhood, all were densely populated neighborhoods. Therefore, a significant number of residents suffered from the lack of open and green space. There was not much multi-story construction, only in the Vatan Neighborhood in the north of the railway. The neighborhood's population density and construction rate were not high, which allowed planning the open and green spaces considering residents' needs. Besides, this region had enough space to construct a city park necessary for Osmaniye city center. The city park, which would be built following the spatial size and equipment standards, would increase the total amount of open and green spaces in Osmaniye city center

On the other hand, the densely populated neighborhoods in the south of the railway where multi-story buildings were prevalent did not have enough space for open and green spaces. It was a severe problem, especially for the Yedi Ocak, Hacı Osmanlı, İstiklal, Baş, Mevlana, Gebeli, and Ahmet Yesevi Neighborhoods, which did not have any open and green spaces. Although most could use other neighborhoods' neighborhood parks and sports fields, they were inadequate in number and size.

The study results showed that the attempts to realize open and green space standards specified in the revised zoning regulation for city centers failed. The open and green space planning should be executed with urban planning and should consider the population density, life quality, and accessibility factors [2, 11].

According to the results obtained from this study, the amount and types of open green areas recommended at the neighborhood level for Osmaniye district are shown in Table 6.

Table 6. Classes and quantities of open and green space recommended primarily at neighborhood level

Neighborhood	**Existing open and green space**			**Required open and green space**		
	open and green space class	**Total area m^2**	**m^2/ person**	**priority open and green space class**	**Total area m^2**	**m^2/ person**
Neighborhoods without open and green spaces						
Vatan	-	0.00	0.00	children playground, neighborhood park, sports field	26670.00	10.00
Ahmet Yesevi	-	0.00	0.00	children playground, neighborhood park, sports field	18510.00	10.00
Yaverpaşa	-	0.00	0.00	children playground, neighborhood park	11980.00	10.00
Şirinevler	-	0.00	0.00	children playground	17770.00	10.00
Mevlana	-	0.00	0.00	children playground, neighborhood park	58250.00	10.00
Baş	-	0.00	0.00	children playground, sports field	41520.00	10.00
İstiklal	-	0.00	0.00	children playground, sports field	62000.00	10.00
Hacı Osmanlı	-	0.00	0.00	children playground, sports field	41230.00	10.00
Yedi Ocak	-	0.00	0.00	children playground, sports field	97810.00	10.00
neighborhoods in the north of the railway where multi-storey construction is not dense						
Yeşil Yurt	1 neighborhood park	2814.11	0.92	children playground, neighborhood park	27695.89	9.08
Dr. İhsan Göknal	1 neighborhood park	3359.68	1.05	children playground, neighborhood park	28530.32	8.95
Yeni	1 neighborhood park	3119.72	0.73	children playground, sports field	39530.28	9.91
Yunus Emre	2 neighborhood park 2 sports field	16868.81	2.67	children playground	46201.19	7.33
neighborhoods with dense multi-storey construction						
Mehmet Akif Ersoy	1 children playground	1028.94	0.07	neighborhood park, sports field	139261.06	9.93
Raufbey	1 children playground	875.40	0.06	neighborhood park, sports field	153154.60	9.94

Rahime Hatun	2 children playgrounds	2547.34	0.19	children playground, sports field	130572.66	9.81
Alibeyli	2 children playgrounds	11.369,83	2.44	sports field	35140.17	7.56
Cumhuriyet	1 neighborhood park	1.584,95	0.17	children playground, sports field	93865.05	9.83
Kurtuluş	1 children playground	1017.88	0.15	children playground, sports field	65842.12	9.85
Eyüp Sultan	1 neighborhood park 1 sports field	5324.19	0.48	children playground, neighborhood park	105115.81	9.52
Esenevler	1 children playground 1 neighborhood park 1 sports field 1 square	17493.00	1.94	children playground	72467.00	8.06
Mimar Sinan	1 children playground 1 sports field	8235.21	0.58	children playground, neighborhood park	133504.79	9.42
Ulaşlı	1 neighborhood park	6283.88	1.35	children playground	40216.12	8.65
Mareşal Fevzi Çakmak	1 children playground 2 neighborhood park	15487.68	1.09	children playground	126742.32	8.91
Rızaiye	1 children playground 1 neighborhood park	9.813,41	1.52	sports field	54436.59	8.48
Ali Bekirli	1 neighborhood park	2.012,31	0.39	children playground	49687.69	9.61
Kazım Karabekir	1 sports field	5.020,98	0.93	children playground	49029.02	9.07
Fatih	1 neighborhood park	3652.87	1.03	children playground	41520.00	8.97
Yıldırım Beyazıt	1 neighborhood park 1 sports field	12615.90	1.67	children playground	62734.10	8.33
Adnan Menderes	1 children playground 1 neighborhood park 1 sports field	17898.83	2.22	children playground, neighborhood park	789501.17	7.78
Karacay	1 neighborhood park	3383.16	0.48	children playground, sports field	67596.84	9.52
Dumlupınar	2 children playgrounds	3.045,97	0.77	neighborhood park, sports field	36574.03	9.23
Haraz	1 neighborhood park 1 sports field	4297.20	1.45	children playground	25242.80	8.55
Fakıuşağı	1 neighborhood park 3 sports field	115373.75	9.51	children playground	5976.25	0.49
Gebeli	1 neighborhood park	2265.21	0.39	children playground, sports field	55174.79	9.61
Selimiye	1 children playground	1776.13	0.41	neighborhood park, sports field	41833.87	9.59

Competing Interest / Conflict of Interest

The authors declare that they no conflict of interest. None of the authors have competing interests in the manuscript.

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An Investigation on Heavy Metal Pb, Zn, Cu, Ni and Cd Accumulation in Leaves of *Robinia Pseudoacacia* L. "Umbraculifera" Arising from Motor Vehicles

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ABSTRACT

The present study aims to determine the level of heavy metal contamination induced by the motor vehicles at Şanlıurfa city center using *Robinia pseudoacacia* L. "Umbraculifera" taxon encountered frequently at the urban landscape planning practices in Turkey. The quantities of the heavy metal levels such as Pb, Zn, Cu, Ni and Cd were determined using ICP OES (Inductively Coupled Plasma Optical Emission Spectrometer) on the leaf samples collected seasonally (spring, summer, autumn seasons). The SPSS 18 Packaged Software was used to determine the significant differences regarding accumulation of the heavy metal levels from the leaves of this plant according to the stations and the seasons, and the homogeneity test was implemented to measure the difference; and the data were analyzed using Kruskal - Wallis and Games - Howell tests. Based on the data acquired as a result of the study, it was concluded that this plant cannot be considered as an indicator for heavy metals originating from motor vehicles in Şanlıurfa.

Anahtar Kelimeler:
Ağır Metal Seviyesi,
Çevresel Kirlilik,
Robinia pseudoacacia
"Umbraculifera",
Şanlıurfa,
Türkiye.

ÖZ

Bu çalışma ile Türkiye'de şehir peyzaj planlamasında çok sık rastlanılan *Robinia pseudoacacia* L. "Umbraculifera" taksonu kullanılarak Şanlıurfa il merkezinde motorlu taşıtların neden olduğu ağır metal kirliliği seviyesinin belirlenmesi amaçlanmıştır. Mevsimsel olarak toplanan yaprak örneklerinde ICP (Inductively Coupled Plasma) kullanılarak Pb, Zn, Cu, Ni ve Cd ağır metal miktarlarının tespiti yapılmıştır. Bu bitkinin yapraklarından ağır metal birikiminin istasyonlara ve mevsimlere göre anlamlı derecede birbirinden farklılığını tespit etmek için SPSS 18 Paket Programı ve farklılığını ölçmek için ise homojenlik testi uygulanmış, Kruskal – Wallis ve Games – Howell testleri ile veriler analiz edilmiştir. Çalışma sonucunda elde edilen verilere göre bu bitkinin Şanlıurfa'da motorlu taşıt kaynaklı ağır metaller için bir indikatör olamayacağı sonucuna varılmıştır.

1. Introduction

The environmental pollution problems have escalated in this era we live in due to consumption of the natural resources and the growth in production practices in order to satisfy the ever increasing needs of the human beings due to the increase in the world population, rapid progression of the technological advancements and improvement at the

standards of living. Therefore, nowadays the pollutants have diversified, especially in developing countries due to development of the industry [1].

Such pollutants emanate from the mining practices, highway traffic, use of fossil fuels, incineration of garbage, use of pesticides and fertilizers, burning of coal for heating purposes and industrial operations, and the municipal waste [2, 3].

Considered to be one of the anthropogenic activities inducing environmental pollution, the vehicle traffic is the primary source of highway pollution [4]. Characteristics such as the exhaust gases, wear of car tires, number and types of cars, fast or slow progress of traffic, etc. leads to contamination by heavy metal such as Cd, Cu, Ni, Pb and Zn on the roadsides [2, 5]. Especially the plants planted for landscaping purposes, especially in the traffic islands, are considered to be most affected by such pollution. The volume of the traffic and the distance to the roadside are the most important factors affecting heavy metal accumulation in plants.

Although the heavy metals are defined as the elements that present metallic properties and have atomic number greater than 20 [6, 7], recently the term "heavy metal" is used to denote any metal and metalloids or semi-metals characterized by potential toxicity to the environment and living organisms [8].

According to WHO [9], 1998 protocol, the metals that are stable and have density greater than 4.5 g/cm^3, and in some cases, the metalloids are denoted as heavy metals. According to WHO [10], Cd (Cadmium), Pb (lead) and Hg (mercury) are the heavy metals that have highest impact on human health. Cobalt (Co), copper (Cu), chromium (Cr), iron (Fe), magnesium (Mg), manganese (Mn), molybdenum (Mo), nickel (Ni), selenium (Se) and zinc (Zn), on the other hand, are considered as the basic nutritional (micronutrients) elements in terms of many biochemical and physiological functions. Insufficient intake of such elements through food causes ailments such as lack of food or lack of vitamins.

It is a fact known for a long time that the plants accumulate trace elements from the atmosphere and are used in various sampling studies, especially because they offer cost-efficient information about environmental quality with the advantage of easy sampling. For this, especially mosses, lichens, herbs, agricultural products, ornamental plants and various tree species are used. [2, 11-15]. The trees are rather used for detecting the heavy metal pollution in the environment. The reasons for such use include more usable biological material, species identification, ease of application and sample collection, and the ubiquity of some species that make it possible to cover large areas [2].

Robinia pseudoacacia L. "Umbraculifera" has been used in many national and international studies as a heavy metal bio-indicator [3, 13, 16-23].

Furthermore, this plant is one of the plants denoted as bio-monitor in determining the heavy metal pollution. [13, 21, 23-26].

Upon reviewing the studies that investigated the potential bio-indication and phytoremediation characteristics of 9 different tree species planted for landscaping along the arterial streets at the downtown areas in central Europe [23], it has been determined that *Betula pendula* and *Robinia pseudoacacia* species are ideal and cost-efficient in terms of phytoremediation.

Accordingly, the fact that it is currently used for landscaping on roadsides with heavy traffic density also makes it extremely suitable plant sample for performing heavy metal measurements.

It is estimated that this plant, originating from Central and North America, was introduced to the Anatolia by the foreign railroad companies engaged with laying of railroad tracks during the Ottoman Empire era and was planted around the railroad stations, road slopes and embankments in order to stop the erosion. In addition to the parks, the plant is especially used at the central refuges and curbsides by the municipalities in Turkey. One of the primary reasons for preference of this plant is that it does not obstruct the sight of the vehicles travelling on the urban roads, thus avoiding any probable accident due to the extremely high body height from the ground to the crowning [27].

The present study aimed to determine the heavy metal pollution induced by motor vehicles in the areas where said plant is used for landscaping purposes at Şanlıurfa city center area, taking into consideration the notion that this plant acts as bio-indicator in terms of heavy metals.

2. Material and Method

Study Area

The leaf samples of *Robinia pseudoacacia* "Umbraculifera" species, used prevalently for afforestation efforts on the roadside and traffic islands in Şanlıurfa, were collected from four stations (Mehmet Hafız Boulevard, GAP Boulevard, Ring road, Mevlana street) comprising of boulevards and streets with intense traffic at the city center. Harran University Osmanbey Campus, 25 km away from the city center and presents low traffic density, was chosen as the control station.

Sampling and Analysis

Leaf samples were collected from the trees selected randomly at these five stations located in different localities throughout Şanlıurfa in the last months of the spring, summer and autumn seasons (May, August, November, 2015). When collecting the samples, 4 plants were selected from various distinct spots of the universe for each station in various seasons and then 3 leaf samples were collected from different points of each plant, and the results representing the ratio of the heavy metal in the leaf with 3 recurrent measurements for each leaf were achieved using ICP OES (Inductively Coupled Plasma Optical Emission Spectrometer).

The samples so collected were labeled individually and stored in separate bags in order to prevent contamination. The leaves on the lower branches of the trees, especially close to the road and exposed to the exhaust gases, were collected from the designated stations. The leaves so collected were washed with tap water and dried in the shade. The coordinates and lengths of the stations where the plant samples are collected are specified hereunder in Table 1.

Table 1. Stations used in the study

Stations	Station Length (km)	Coordinate
Osmanbey Campus	1	37°10'18.8"N 38°59'58.8"E
Gap Boulevard	4	37°12'47.1"N 38°47'49.8"E
Mehmet Hafız Boulevard	3,1	37°12'36.3"N 38°48'01.1"E
Ring Road	4,3	37°10'49.3"N 38°49'02.0"E
Mevlana Street	3,3	37°09'11.0"N 38°48'30.5"E

The samples dried for taking readings on the ICP OES device were maintained in the drying oven at 110^0C for 3 hours and dehydrated. The samples removed from the drying oven were pulverized by grounding in mortar. After collecting 0.5 g of the pulverized samples using precision scales, the samples were maintained in the muffle furnace at 550^0C for 5 hours to turn into ash, and then 7 ml of nitric acid was added to the samples and taken into the solution under high pressure and temperature in the microwave oven. The samples removed from the microwave oven were filtered. The samples were completed to 14 ml using distilled water and placed in the ICP OES device for getting readings.

Data Analysis

When determining the sample size of the study, the data were analyzed using G-Power 3.1.9.4 packaged software. The sample size was determined by analyzing the samples that will represent the universe size for each station during various seasons with 80% power and 5% error rate after determining the effect size.

The data were analyzed using SPSS 18 Packaged Software in order to determine the significant differences regarding accumulation of heavy metals in the leaves based on stations and seasons. In the analysis, Kruskal - Wallis, Games - Howell and Homogeneity tests were employed to measure the significant differences regarding accumulation of heavy metals in the leaves of the plant under study during various seasons based on the stations and at the designated stations based on various seasons.

It was determined that the values read for Cd (Cadmium) did not produce any statistically significant (<0.05) result. Therefore, said element is not shown in the assessment table.

3. Results

In this study, G-Power power analysis has been used to determine the sample number that shall represent the universe size under study from the available sample results by computing the effect sizes.

Based on the findings from this analysis, the acceptable sample number for each station was determined for each season when the study was conducted for 4 elements (Pb, Zn, Cu, Ni). When determining the sample number, the highest sample number for said elements was preferred (Table 2).

Table 2. Sample Numbers for the Elements according to G-Power Power Analysis

Seasons	Stations	Sample Number				
		Pb	**Zn**	**Cu**	**Ni**	**Accepted**
Spring	Osmanbey Campus	68	60	76	198	198
	Gap Boulevard	108	160	100	48	160
	Mehmet Hafiz Boulevard	96	148	100	168	168
	Ring Road	60	68	64	60	68
	Mevlana Street	76	52	120	104	120
Summer	Osmanbey Campus	72	72	68	176	176
	Gap Boulevard	92	52	80	92	92
	Mehmet Hafız Boulevard	120	88	160	172	172
	Ring Road	116	52	144	60	144
	Mevlana Street	124	96	80	104	124
Autumn	Osmanbey Campus	60	108	72	88	108
	Gap Boulevard	52	92	44	76	92
	Mehmet Hafız Boulevard	144	184	128	48	184
	Ring Road	128	104	108	52	128
	Mevlana Street	60	160	76	172	172

Evaluation of Statistical Analysis

The distribution of heavy metal concentrations in the washed leaf samples of the plant according to the stations used for sampling in line with the results of the analysis is given in Table 3.

Table 3. The element concentrations in *Robinia pseudoacacia* leaves from the stations (mg*kg^{-1})

Sampling Station	Pb	Zn	Cu	Ni
Osmanbey Campus	2.076±0.1131	36.12±3.736	4.330±0.2522	1.467±0.728
GAP Boulevard	4.202±0.3127	21.67±1.341	4.994±0.3244	3.058±0.1369
Mehmet Hafız Boulevard	3.717±0.2042	19.02±0.529	4.418±0.3461	3.231±0.1584
Ring Road	4.527±0.1718	17.91±1.493	4.732±0.3426	3.492±0.2197
Mevlana Street	4.064±0.1743	21.90±1.976	4.623±0.3388	3.224±0.1232

All metal concentrations shown as Mean±SD

Accordingly, the station with the highest measured Pb value is the Ring Road, followed by GAP Boulevard, Mevlana Street and Mehmet Hafiz Boulevard stations, respectively. The lowest measured Pb value was achieved from Osmanbey Campus selected as the control station.

The highest Zn value was measured in Osmanbey Campus, which is the ground control station, and the lowest value was obtained from the Ring Road.

The highest of Cu was measured in GAP Boulevard station, followed by the Ring Road, Mevlana Street and Mehmet Hafız Boulevard stations, respectively. The lowest value for the Cu element was measured also from the control station, Osmanbey Campus.

When we look at the values for the Ni element, the highest value was measured at the Ring Road station and the lowest value was measured from the control station, Osmanbey Campus.

The distribution of heavy metal concentrations in the washed leaf samples of the plant according to the seasons in which the samples were taken is also given in Table 4.

Table 4 The element concentrations in *Robinia pseudoacacia* leaves for the seasons (mg*kg^{-1})

Sampling Season	**Pb**	**Zn**	**Cu**	**Ni**
Spring	2.650±0.1348	15.56±0.828	5.523±0.3079	3.310±0.1805
Summer	2.974±0.1443	31.67±3.364	6.038±0.2877	2.102±0.1029
Autumn	5.527±0.2429	22.74±1.072	2.297±0.2224	3.271±0.1746

All metal concentrations shown as Mean±SD

Accordingly, the season with the highest Pb value is observed to be the autumn, which is followed by the summer and spring seasons, respectively. On the other hand, the highest Zn and Cu values were measured in the summer season, while the lowest values were measured in spring for Zn and in autumn for Cu. The highest Ni value was also measured in the spring season.

The Statistical Evaluation of Heavy Metals According to the Stations

Homogeneity and Kruskal Wallis test results for accumulation of heavy metals, Pb, Zn, Cu and Ni, analyzed in the study in the leaves during three seasons according to five stations are given in Tables 5 and 6.

Table 5. Test of Homogeneity of Variances

Element	**Levene Statistic**	**df1**	**df2**	**Sig.**
Pb	2,000	4	10	,171
Zn	6,736E15	4	5	,000
Cu	3,892E16	4	5	,000
Ni	3,521E15	4	5	,000

Table 6. Kruskal Wallis Test Statistics

Element		Average Value
Pb (Lead)	-	-
Zn (Zinc)	Chi-square	54,475
	Df	2
	Asymp. Sig.	,000
Cu (Copper)	Chi-square	8,375
	Df	4
	Asymp. Sig.	,079
Ni (Nickel)	Chi-square	4,806
	Df	4
	Asymp. Sig.	,308

In the study, Homogeneity and Normality tests were implemented on accumulation of Pb, Zn, Cu and Ni on the leaves during three seasons according to five stations. Accordingly, the test results obtained for Zn, Cu and Ni revealed that the factor group of the data did not present normal distribution over the dependent group and was not distributed homogeneously, whereas, the factor group of the data were distributed normally and presented homogeneous distribution for Pb (Table 5).

The data for Pb were analyzed by One-Way Analysis of Variance, and it was observed that the accumulation of Pb on leaves was not significantly different (<0.05) between stations compared to five stations during three seasons (Table 7).

Table 7. ANOVA results

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	3,067	4	,767	1,438	,292
Within Groups	5,333	10	,533	-	-
Total	8,400	14	-	-	-

The data for Zn, Cu and Ni, on the other hand, were analyzed using the Kruskal Wallis Test, the Chi-Square value was determined, and it was observed that there was no significant difference (<0.05) in the accumulation of Cu and Ni in leaves, while a significant (<0.01) difference was observed (Table 6) for Zn between the stations compared to five stations in three seasons.

The data for Zn were analyzed using the Games-Howell Test in the non-parametric plane, and it was observed that accumulation of Zn in leaves presented significant (<0.05) difference between Osmanbey Campus and GAP Boulevard stations (Table 8 and Figure 1).

Table 8. Games-Howell Multiple Comparison Results for Zn

(I) Stations	(J) Stations	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
					Lower Bound	Upper Bound
Osmanbey Campus	GAP Boulevard	-53,00000*	3,80789	,048	-104,6167	-1,3833
	Mehmet Hafız Boulevard	-25,00000	5,70088	,257	-132,6687	82,6687
	Ring Road	-19,00000	7,64853	,465	-184,9919	146,9919
	Mevlana Street	-25,50000	3,35410	,094	-64,9883	13,9883
GAP Boulevard	Osmanbey Campus	53,00000*	3,80789	,048	1,3833	104,6167
	Mehmet Hafız Boulevard	28,00000	6,51920	,178	-33,8316	89,8316
	Ring Road	34,00000	8,27647	,228	-69,8677	137,8677
	Mevlana Street	27,50000	4,60977	,084	-8,9369	63,9369
Mehmet Hafız Boulevard	Osmanbey Campus	25,00000	5,70088	,257	-82,6687	132,6687
	GAP Boulevard	-28,00000	6,51920	,178	-89,8316	33,8316
	Ring Road	6,00000	9,30054	,952	-73,4538	85,4538
	Mevlana Street	-,50000	6,26498	1,000	-68,5440	67,5440
Ring Road	Osmanbey Campus	19,00000	7,64853	,465	-146,9919	184,9919

	GAP Boulevard	-34,00000	8,27647	,228	-137,8677	69,8677
	Mehmet Hafız Boulevard	-6,00000	9,30054	,952	-85,4538	73,4538
	Mevlana Street	-6,50000	8,07775	,905	-122,7642	109,7642
Mevlana Street	Osmanbey Campus	25,50000	3,35410	,094	-13,9883	64,9883
	GAP Boulevard	-27,50000	4,60977	,084	-63,9369	8,9369
	Mehmet Hafız Boulevard	,50000	6,26498	1,000	-67,5440	68,5440
	Ring Road	6,50000	8,07775	,905	-109,7642	122,7642

*. The mean difference is significant at the 0.05 level.

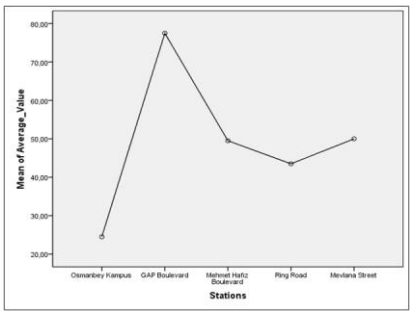

Figure 1. One-Way Analysis of Variance Diagram for Zn **(*** Every 1 unit on the diagram represents 0,5 mg / kg)

The Statistical Evaluation of Heavy Metals According to the Seasons

Homogeneity and Kruskal Wallis test results for accumulation of heavy metals, Pb, Zn, Cu and Ni, analyzed in the study in the leaves at five stations according to three seasons are given in Tables 9 and 10.

Table 9. Test of Homogeneity of Variances

Element	**Levene Statistic**	**df1**	**df2**	**Sig.**
Pb	12,750	2	132	,000
Zn	7,463	2	132	,001
Cu	9,174	2	132	,000
Ni	8,331	2	132	,000

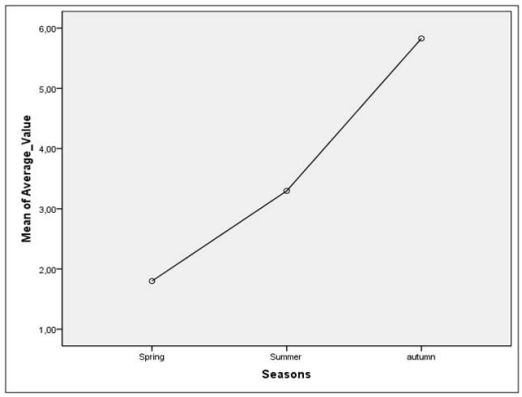

Figure 2. One-Way Analysis of Variance Diagram for Pb **(*** Every 1 unit on the diagram represents 2,5 mg / kg)

In the study, Homogeneity and Normality tests were implemented for accumulation of Pb, Zn, Cu and Ni in leaves at five stations according to three seasons. The test results revealed that the factor group of the data did not present normal distribution over the dependent group and was not distributed homogeneously (Table 9).

The data were analyzed using the Kruskal Wallis Test; the Chi-Square value was determined, and it was observed that the accumulation of Pb, Zn, Cu and Ni in leaves presented an extremely significant (<0.01) difference between the seasons at five stations according to three seasons (Table 10).

Table 10. Kruskal Wallis Test Statistics

Element		Average Value
Pb (Lead)	Chi-square	51,955
	Df	2
	Asymp. Sig.	,000
Zn (Zinc)	Chi-square	53,948
	Df	2
	Asymp. Sig.	,000
Cu (Copper)	Chi-square	53,891
	Df	2
	Asymp. Sig.	,000
Ni (Nickel)	Chi-square	55,676
	Df	2
	Asymp. Sig.	,000

The data for Pb, Zn, Cu and Ni were analyzed using the Games-Howell Test in the non-parametric plane (Table 11). It was observed that accumulation of Pb in the leaves presented an extremely significant (<0.01) difference between spring, summer and autumn seasons, that accumulation of Zn in the leaves did not present any significant difference between spring and autumn seasons, but presented an extremely significant (<0.01) difference between summer and spring and autumn seasons, that accumulation of Cu in the leaves did not present any significant difference between spring and summer seasons, but presented an extremely significant (<0.01) difference between autumn and spring and summer seasons, and, finally, accumulation of Ni in the leaves did not present any significant difference between spring and autumn seasons, but presented significant (<0.05) difference between summer and spring seasons, and presented an extremely significant (<0.01) difference between summer and autumn seasons (Figure 2, 3, 4, 5).

Table 11. Games-Howell Multiple Comparison Results

(I) Seasons		(J) Seasons	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval	
						Lower Bound	Upper Bound
Pb	Spring	Summer	-1,49665*	,23997	,001	-2,1790	-,8143
		Autumn	-4,02860*	,33407	,000	-4,8588	-3,1984
	Summer	Spring	1,49665*	,23997	,001	,8143	2,1790
		Autumn	-2,53195*	,29864	,000	-3,2432	-1,8207
	Autumn	Spring	4,02860*	,33407	,000	3,1984	4,8588
		Summer	2,53195*	,29864	,000	1,8207	3,2432
Zn	Spring	Summer	3,39566*	,56779	,006	1,4923	5,2990
		Autumn	,63294	,62673	,595	-1,2250	2,4909
	Summer	Spring	-3,39566*	,56779	,006	-5,2990	-1,4923
		Autumn	-2,76272*	,33938	,000	-3,5710	-1,9544
	Autumn	Spring	-,63294	,62673	,595	-2,4909	1,2250
		Summer	2,76272*	,33938	,000	1,9544	3,5710
Cu	Spring	Summer	,19566	,41857	,889	-1,1875	1,5788
		Autumn	-2,42860*	,47341	,002	-3,7898	-1,0674
	Summer	Spring	-,19566	,41857	,889	-1,5788	1,1875
		Autumn	-2,62426*	,28163	,000	-3,2951	-1,9534
	Autumn	Spring	2,42860*	,47341	,002	1,0674	3,7898
		Summer	2,62426*	,28163	,000	1,9534	3,2951
Ni	Spring	Summer	4,05720*	,93738	,025	,7806	7,3338
		Autumn	1,40217	,96362	,389	-1,8163	4,6206
	Summer	Spring	-4,05720*	,93738	,025	-7,3338	-,7806
		Autumn	-2,65503*	,29538	,000	-3,3581	-1,9519
	Autumn	Spring	-1,40217	,96362	,389	-4,6206	1,8163

Summer	2,65503*	,29538	,000	1,9519	3,3581

*. The mean difference is significant at the 0.05 level.

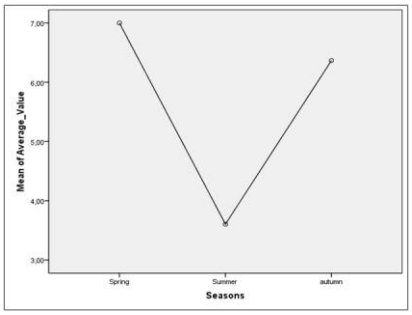

Figure 3. One-Way Analysis of Variance Diagram for Zn **(*** Every 1 unit on the diagram represents 2,5 mg / kg)

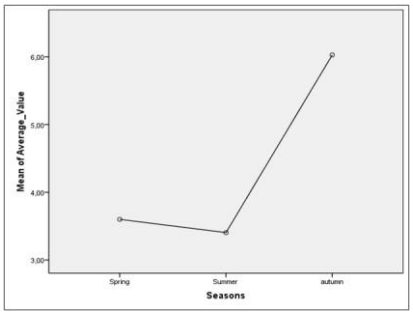

Figure 4. One-Way Analysis of Variance Diagram for Cu **(*** Every 1 unit on the diagram represents 0,5 mg / kg)

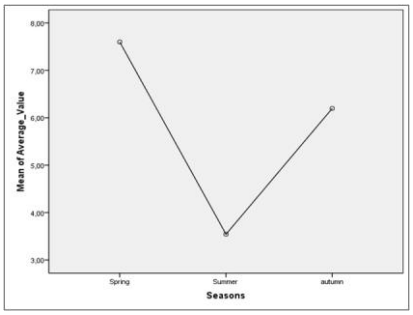

Figure 5. One-Way Analysis of Variance Diagram for Ni (* Every 1 unit on the diagram represents 0,5 mg / kg)

4. Discussion

Robinia pseudoacacia L. has been used as heavy metal bioindicator within both domestic and foreign [3, 13, 16-23, 26] many studies. It is currently used for landscaping on the roadsides with heavy traffic density so this makes it a very suitable plant sample for heavy metal measurements.

The present study was conducted in contemplation that investigating accumulation of the heavy metals, Pb, Zn, Cu, Ni and Cd, in the leaves of *Robinia pseudoacacia* L. "Umbraculifera" in Şanlıurfa (Central District) due to motor

vehicles would yield significant results. Accordingly, it was investigated whether the heavy metal accumulation in the leaves differs significantly from each other according to the stations (Osmanbey Campus, GAP Boulevard, Mehmet Hafız Boulevard, Ring Road, Mevlana Street) and various seasons (spring, summer, autumn). According to the results obtained from the leaf samples read on the ICP OES device, it was seen that all readings for the Cd element did not present any results at the level of statistical significance, and thus it was concluded that accumulation of Cd in the leaves did not present any difference according to the stations and seasons.

Upon reviewing the results obtained from the analysis in terms of seasonality, it was determined that, although accumulation of Pb and Cu elements in leaves was at lower values during the spring months when the leaves first started to form, said value increased towards the summer and autumn months due to exposure to the heavy metals originating from the external environment. Accordingly, it was seen that the plant could not remove Pb and Cu elements from its leaves.

Several other studies conducted with this plant [18, 28] further revealed that the level of Pb, Zn and Cu in the leaves increased in autumn, corresponding to the end of the growth phase.

When we look into the Ni and Zn elements, it is seen that the accumulation in the leaves is at high levels in the spring, then declines towards the summer months, and then rises again towards the autumn months.

The review on acquired data in terms of stations revealed that the Pb, Zn and Cu values in the samples from GAP Boulevard and Ring Road, which feature the highest traffic density in terms of motor vehicles among the stations, are higher than the other samples. Determination of the statistically significant difference between GAP Boulevard, Ring Road and Mevlana Street stations, where motor vehicles are more concentrated, and Osmanbey Campus station, where motor vehicle traffic is relatively less intense, in terms of the Pb quantity in the leaves reveals that motor vehicles also have an impact on accumulation of Pb in the leaves apart from the natural factors.

On the other hand, according to the analysis results, Pb and Ni values were found to be within the normal range for plants, while Cu and Zn values were found to be lower than normal values.

In similar studies [16, 17, 19, 20] using the same plant on this subject, the heavy metal amounts of the samples from the research area were higher than the samples from the control areas, and consequently this plant has been indicated as a bioindicator.

However, in the light of the data from our study, in which the same plant and similar methods were used , we determined that this plant is not suitable as a bioindicator in our study areas.

Based on the aforementioned result, the concept of bioindicator species as propounded for this plant by the past studies as set forth in the introduction chapter of the study does not coincide with the outcome of this study conducted specifically for Şanlıurfa. Numerous reasons underlining this result can be sought. First of all; the difference in the field of study, such as the fact that past studies regarding determination of the heavy metal accumulation on this plant were carried out at the old mine and industrial zones or along the route of the international road might have led to such outcome. Secondly, achievement of different results despite conducting the studies at the city centers as is the case for several other previous studies can be attributed to the factors such as the size of the city centers, the number of vehicles in the traffic, the age of the vehicles in the traffic, vehicle maintenance, the quality of the fuel used in the vehicles, and traffic density.

In conclusion, it is contemplated that indicating situations such as the annual number of vehicles introduced to the traffic in the region, the daily vehicle density at the sampling area, the length of the boulevard or street used for sampling etc. when conducting studies on the traffic-based heavy metals similar to the study presented herein would provide more realistic and robust opportunity for comparing the results from the studies conducted in different fields.

Competing Interest / Conflict of Interest

"The authors declare that they have no competing interests”

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How Can Natural Environment Scoring Tool (Nest) be Adapted for Urban Parks?

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ABSTRACT

Urban Parks, which are important elements of the urban environment, have many beneficial effects on people. They also increase the quality of life. The features, facilities, and possibilities of the parks are determined and evaluated by the users to increase qualityof these areas. This study aimed to develop a tool for evaluating the natural environments in different cities, supporting various uses, and determining the relationship between natural environment quality and user satisfaction levels. In the study conducted in the park areas selected from Jakarta and Ankara cities, the users of the area were scored according to the natural environment typologies of the areas with the Natural Environment Scoring Tool (NEST). The data obtained as a result of scoring were evaluated by correlation analysis. Within the scope of the analysis, it was an important result that access, facilities, aesthetics, safety, threats and usability typologies strongly affect the users' satisfaction levels. In addition, the study laid the groundwork for the development of a more comprehensive scoring system in terms of demonstrating the applicability of NEST for urban parks and ensuring the participation of users.

Anahtar Kelimeler:
Kent parkı,
NEST,
Kullanılabilirlik,
Ankara,
Jakarta.

ÖZ

Park alanlarının insanlar üzerinde birçok yararlı etkisi bulunmaktadır. Kentsel çevrenin önemli unsurları olan park alanları yaşam kalitesinin arttırılmasını da sağlamaktadır. Park alanlarının özelliklerinin, tesislerinin ve olanaklarının tespit edilerek kullanıcılar tarafından değerlendirilmesi bu alanların kalitelerini arttırmak için gereklidir. Çalışmada, çeşitli kullanımları da destekleyen, farklı kentlerde olan doğal ortamların değerlendirilmesinde bir araç geliştirmek ve doğal çevre kalitesi ile kullanıcıların memnuniyet düzeyleri arasındaki ilişkinin belirlenmesi amaçlanmıştır. Jakarta ve Ankara kentlerinden seçilen park alanlarında yapılan çalışmada, alan kullanıcıları tarafından Doğal Çevre Değerlendirme Aracı (NEST) ile alanların doğal çevre tipolojilerine göre puan verilmiştir. Puanlama sonucunda elde edilen veriler korelasyon analizi ile değerlendirilmiştir. Analiz kapsamında erişim, olanaklar, estetik, güvenlik, tehditler ve potansiyel kullanım tipolojilerinin kullanıcıların memnuniyet düzeylerini güçlü düzeyde etkilemesi ulaşılan önemli bir sonuç olmuştur. Ayrıca çalışma NEST'in park alanlarında uygulanabilirliğini ortaya koyması ve kullanıcıların da katılımını sağlaması açısından daha kapsamlı bir puanlama sistemi geliştirilmesine zemin hazırlamıştır.

1. Introduction

With rapid population growth and urbanization, the pressure on urban areas is also increasing. As a result of these pressures, various problems arise in urban areas [1, 2]. Parks, one of the most important urban areas are common use areas that enable people to perform various recreational activities such as walking, strolling, resting, and being in touch with nature. Urban parks, one of the most important resources for recreation, are also the most important elements of the urban environment [3, 4]. They increase the quality of life by affecting people both physically and mentally and also enable physical activities, reduce stress, and encourage social interaction [5, 6]. At the same time, they provides the opportunity for children and young people to perform sports activities [7, 8]. In this context, park quality plays an important role in determining the purpose of park usage. The number of various usage areas they contain, the features that encourage physical activity such as playgrounds, basketball courts, water elements, shelter, picnic areas, and asphalt tracks make these areas more attractive by increasing the use of parks. However, negative situations such as environmental pollution and vandalism block the use of parks [9, 10].

The recreational use of urban parks has recently increased significantly. With this increase, various problems such as environmental pollution and air pollution have emerged in cities. There are various studies in the literature to solve these problems [11-17]. Recreational activities play an essential role in people's healthy lifestyles [18-19-20-21]. Therefore, solving environmental problems is of great importance in terms of increasing the quality of park areas. Visiting urban parks is the most important activity for people to spend their free time. In parks, they can perform various activities such as walking and jogging. Urban parks are basic public service facilities that are considered important areas for city dwellers to engage in daily leisure activities. Therefore, focusing on leisure activities in urban parks is an important task for park management [21-24].

During rapid urbanization and the COVID-19 pandemic, determining people's attitudes towards urban parks will make an important contribution to determine how they perceive urban parks and their level of participation [21]. In addition, determining the attitudes of people in urban parks towards these areas helps to structure various interventions for positive attitudes because the attitude towards these areas has an important role in increasing the frequency of visiting park areas and increasing satisfaction [25-30].

This study aims to create a scale to measure people's attitudes towards urban parks. In this context, Monas and Menteng parks in Jakarta, Harikalar Diyari, and Altinpark areas in Ankara were evaluated using the Natural Environment Scoring Tool (NEST), and people's satisfaction with these urban parks was investigated.

2. Material and Method

The research was carried out in urban parks in 2 different cities. The first of these cities is Ankara, the capital city of Turkey. The province is located between latitude 39° 57 'N and longitude 32° 53' E. The surface area of the city is 25,632 km², and its height above sea level is 894 m. Approximately 50% of the province's surface area established in a plain area consists of agricultural lands, 28% forest and scrub lands, 12% meadows and pastures, and 10% non-agricultural lands. There are 16 urban parks in the province, where the green land per person is 19.79 m². The total surface area of these urban parks is 3,675,069 m² [31]. Altinpark and Harikalar Diyari were selected as the study area (Figure 1).

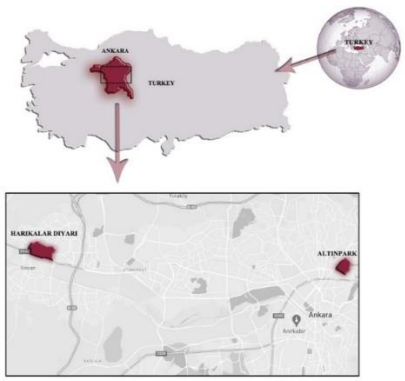

Figure 1. Location map of selected parks in Ankara (Original, 2021)

The second field of study is in Jakarta, the capital city of Indonesia. Jakarta is located between latitude 6° 10 ' S, and longitude 106° 49' E. Jakarta's surface area is 7,659,020 km², and its altitude is 7 m. approximately 26% of the city area is agricultural lands, and 69% is forest lands. There are 12 urban parks in the city with a green land of 2.3 m² per person [32]. Menteng Park and National Monument Park (Monas) were chosen as the study area (Figure 2).

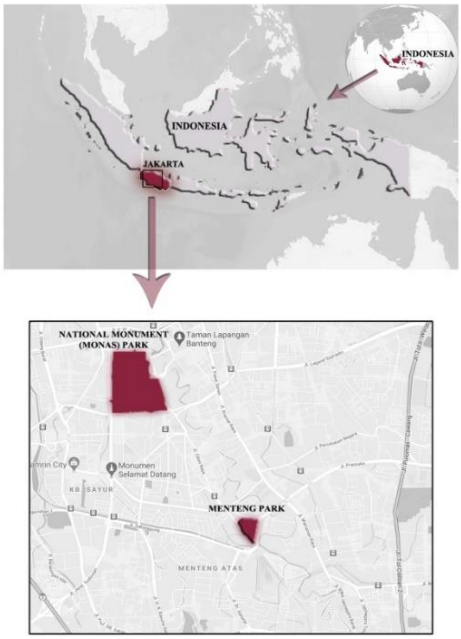

Figure 2. Location map of selected parks in Jakarta (Original, 2021)

The characteristics of these parks are given in Table 1. The diversity of activities in the park areas is important in terms of evaluation.

Table 1. Characteristics of the study area

PARK NAME	COVERED AREA (m²)	ACTIVITIES
ALTINPARK	640,000	32.000 m² artificial lake Amp Water items Water games with music Fishing Boat ride
HARIKALAR DIYARI	1,300,000	Wedding hall Fitness center Cultural center 28 km hiking trail 25.000 m² dream island 91.510 m² artificial lake Cruise by kayak and water bikes Restaurant Amp Car racing tracks Car park

MENTENG PARK	300,000	Children's playgrounds sports fields Running tracks Car park Restaurant Exhibition and greenhouse areas
NATIONAL MONUMENT (MONAS) PARK	1,000,000	National monument Sculptures Sports fields Green lands Water items Flower garden Walking path

In the research, urban parks were evaluated by a total of 260 volunteers from Ankara and Jakarta with the survey technique. A 5-point Likert scale was used in the research questions (1: Strongly Disagree, 5: Strongly Agree). In the first part of the questionnaire, questions were asked to determine the demographic characteristics of the participants. In the second part, the general evaluations of the participants about the urban parks were questioned. In the third part, points were given to the characteristics of the urban parks determined by the participants using the Natural Environment Scoring Tool (NEST).

NEST is a comprehensive quality assessment tool developed for in situ evaluations of the various natural environments in different European cities. In their study [33], developed a scoring system consisting of 8 sections and 47 criteria through existing studies, expert opinions, and field studies in order to evaluate urban parks and neighborhood parks in 4 European cities. Within the scope of the study, NEST criteria were adapted as 53 criteria under seven headings to determine the factors that will affect the use of urban parks (Table 2)

Table 2. NEST criterias

Main Topics	Criterias	Referance
Environment	The appearance of the buildings Building maintenance The connection between the park and the environment	
Access	Entry points (quantity) Walking paths (amount) Walkways (quality) Bicycle paths (amount) Bicycle paths (quality) Parking (amount) Parking (quality) Disability arrangements (amount) Disability regulations (quality)	[10] [33] [34] [35]
Facility	Children's playgrounds (amount) Children's playgrounds (quality) Water facilities (quantity) Water facilities (quality) Skateboard ramps (amount) Skateboard ramps (quality) Courtyards (amount) Courtyards (quality) Green area (amount) Garbage cans (quantity) Picnic tables (quantity) Picnic tables (quality) Fountain (amount) WC (amount) Cafe / restaurant (quantity) Cafe / restaurant (quality) Sports fields (amount) Sports fields (quality) Outdoor furniture (quantity)	[10] [33] [35] [36]

	Outdoor furniture (quality)	
Aesthetics	Surface materials (quantity) Surface materials (quality) Plant amount Plant diversity (proficiency) Plant arrangements (quality) Decorative water items (quality)	
Safety	Lighting (amount) Lighting (quality) Safety regulations for vehicles (qualification) Safety arrangements for pedestrians (qualification)	[35] [37]
Threats	Alcohol use Drug Annoying noise / noise Smell Damage to public property	[10] [33] [35] [36]
Usability	Sport Walk Landscape viewing Children's playgrounds Social activity Soothing, relaxing effect	[10] [33] [35] [38]

The data obtained as a result of scoring were evaluated by creating a database in the SPSS 22.0 software. First, the reliability of the data was tested, and the data were used in the study as "highly reliable" (Table 3). Then the data were evaluated by correlation analysis.

Table 3. Reliability analysis

Criterias	**Cronbach'sAlpha**	**N of Items**
Environment	**,821**	**7**
Access		
Facility		
Aesthetics		
Safety		
Threats		
Usability		
0.00 <0.40 is not reliable *0.40 <0.60 is low reliability* *0.60 <0.80 is very reliable and* *0.80 <1.00 is highly reliable*		

3. Results

The demographic profiles of the participants in the survey conducted in Ankara and Jakarta are given in Table 4. 52% of the participants in Ankara were man and 48% were women. It is observed that these participants are predominantly in the age range of 38% (26-35 age) and 32% (36-45 age). When the educational status of the participants was evaluated, it was seen that 42% of them had a university education. 56% of the participants in Jakarta were women, and 44% were man. 55% of the participants, who are predominantly in the age range of 66% (18-25 age), stated that they had a university education.

Table 4. Demographic profile of the participants

	Attributes	**Attribute Groups**	**n**	**%**
ANKARA	Gender	Women	62	48
		Men	68	**52**
	Age	18-25	29	22
		26-35	49	**38**
		36-45	42	32
		46-55	10	8
		56+	0	0
	Education	Primary school	0	0
		Middle School	0	0
		High school	47	36
		University	55	**42**

		Postgraduate	28	22
JAKARTA	Gender	Women	73	**56**
		Men	57	44
	Age	18-25	9	7
		26-35	86	**66**
		36-45	18	14
		46-55	17	13
		56+	0	0
	Education	Primary school	18	14
		Middle School	17	13
		High school	11	8
		University	72	**55**
		Postgraduate	12	10

In the second part of the survey, the general evaluations of the participants about the urban parks were questioned. The general evaluations of the participants are given in Figure 3. According to these data;

53% of the participants in Ankara stated that they came to Altinpark and Harikalar Diyari with their families. In Jakarta, 65% of the participants stated that they came to Monas Park with their families, while 49% stated that they came to Menteng Park with their friends.

37% of the participants in Ankara stated that they came to Altinpark and Harikalar Diyari for nature excursions. While 33% of the participants in Jakarta stated that they came to Monas Park for hiking, 58% stated that they came to Menteng Park for physical activity.

While 58% of the participants in Ankara stated that they spent 1-2 hours in Altınpark, 62% stated that they spent 2-4 hours in Harikalar Diyari. Equally, 44% of the participants in Jakarta stated that they spent between 1-2 and 2-4 hours in Monas Park. 39% of them stated that they spent 1-2 hours in Menteng Park.

While 61% of the participants in Ankara stated that they came to Altinpark and 73% to Harikalar Diyari with their private vehicles; In Jakarta, 60% of the participants stated that they came to Monas Park, 48% to Menteng Park with their private vehicles, and 43% of them stated that they came to Menteng Park by using public transportation.

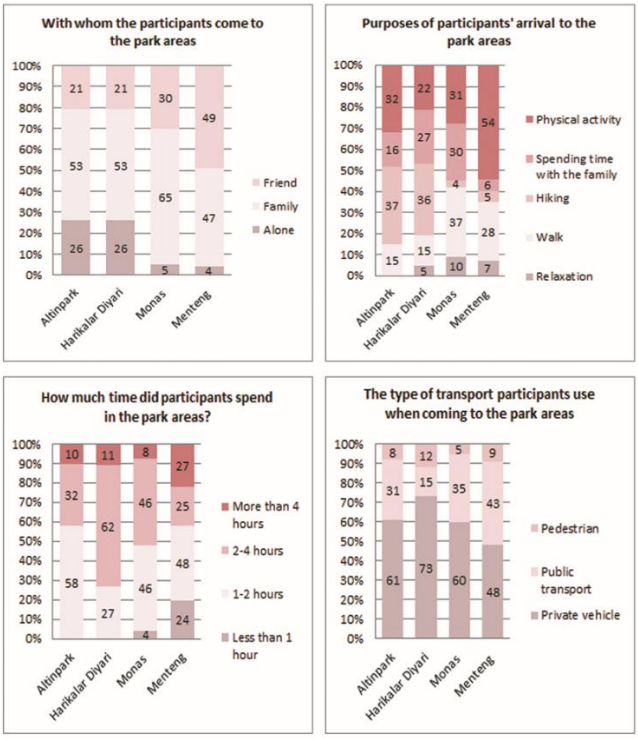

Figure 3. The general evaluations of the participants about the parks.

Then the obtained NEST scores were compared according to the urban parks. The average NEST scores of the parks are given in Figure 4. According to these scores:

The highest average overall scores belong to Menteng and Monas parks in Jakarta. The prominent criteria in these parks were Environment, access, aesthetics, safety and usability.

In the "Environment and Access" criterion, the highest average NEST scores were in Menteng Park and the lowest NEST scores were in Altinpark,

In the "Facility" criterion, the highest NEST scores were in Altinpark and Harikalar Diyari and the lowest NEST score was in Monas Park,

In the "Aesthetics and Safety" criterion, the highest NEST score was in Monas Park and the lowest NEST scores were in Altinpark and Menteng Park,

In the "Threats" criterion, which shows no existence of threat in the field, the highest NEST score was in Altinpark, the lowest NEST score was in Menteng Park,

In the "Usability" criterion, the highest NEST score was seen in Menteng Park and the lowest NEST score was seen in Harikalar Diyari.

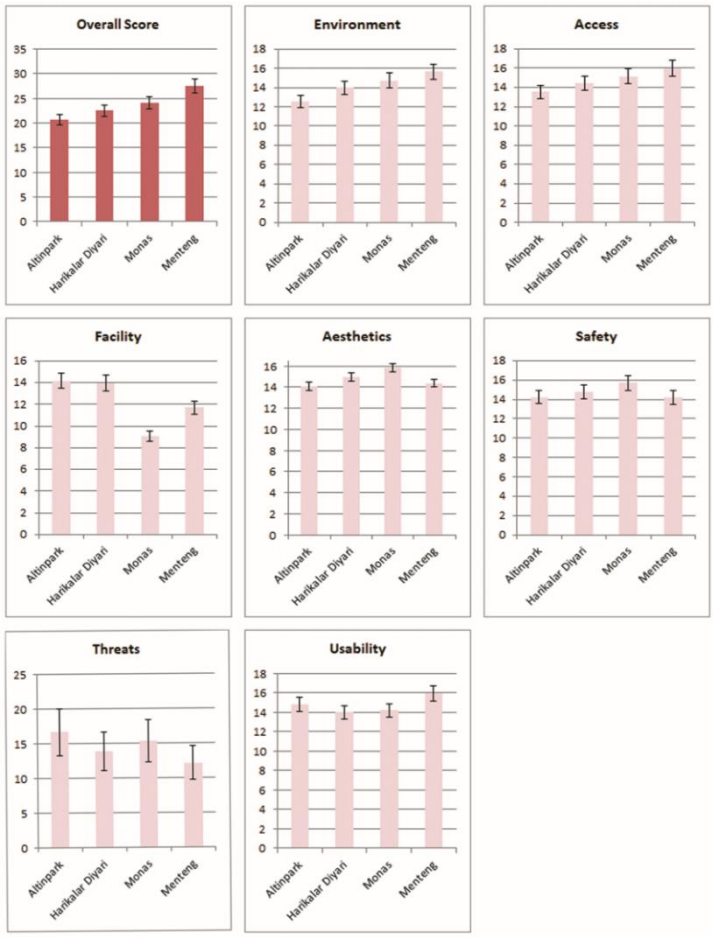

Figure 4. Average NEST scores according to natural environment criteria (With 95% CI error bars)

As a result of the analysis, the average score for the field typology for each criterion was calculated and a general score was obtained. In Figure 5, the effect values for the general scores of the parks as percentage for each natural environment criterion are given. According to these values:

- "Usability features" in Ankara Altinpark, having activity areas such as sports, walking, children's playgrounds in the park constitutes a large part of the overall scoring (16.62%), while "Environment" constitutes the smallest part (12.56%).
- In Harikalar Diyari, on the other hand, "Aesthetics" constitutes the majority of the overall scores (14.94%) and "Threats" constitute a small part (13.85%).
- A large part of the overall scores (15.81%) in Jakarta Monas Park is "Aesthetics" and a small part (9.8%) of the scoring is "Facilities".
- In Menteng Park, a large part of the overall scores (16%) constitutes the "Access" criterion, while the small part (11.71%) of the scores were "Facilities".

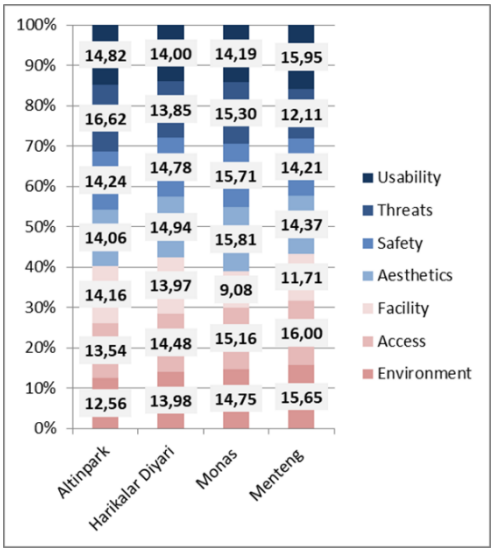

Figure 5. Distribution (%) of NEST scores by urban parks

The correlation analysis results to determine to what extent the gender, age, and educational status of the participants affect their evaluation are given in Table 5. There appears to be a negative correlation between the gender and satisfaction levels of the participants. This situation shows that the satisfaction level of women from the urban parks in Ankara and Jakarta is higher than that of man. It is observed that there is no statistically significant difference between the ages of the participants and their level of satisfaction, and the age factor does not affect satisfaction. It is seen that there is a strong correlation between the education levels of the participants and the satisfaction levels of the urban parks in Ankara. As the education level of the participants increased, their satisfaction level increased. There is no statistically significant difference between the education levels of the participants and the satisfaction of the urban parks in Jakarta.

Table 5. Correlation analysis between the demographic profile of the participants and their satisfaction levels

DEMOGRAPHIC INFORMATION OF PARTICIPANTS			SATISFACTION
Gender	Ankara	Pearson Correlation (r)	-,174*
		Sig. (2-tailed)	,048
	Jakarta	Pearson Correlation (r)	-,275**
		Sig. (2-tailed)	,002
Age	Ankara	Pearson Correlation (r)	,034
		Sig. (2-tailed)	,703
	Jakarta	Pearson Correlation (r)	,062
		Sig. (2-tailed)	,487

Education	Ankara	Pearson Correlation (r)	,293**
		Sig. (2-tailed)	,001
	Jakarta	Pearson Correlation (r)	,095
		Sig. (2-tailed)	,282

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*
r = 0.10-0.29(weak)
r = 0.30-0.49(medium)
r = > 0.50(strong)

The correlation analysis results to determine to what extent the average scores of the NEST criteria affect the satisfaction levels of the participants are given in Table 6. It seems that the "environment" criterion is not a quality that affects the satisfaction levels of the parks in Ankara and Jakarta. There appears to be a strong correlation between the "access" criterion and the satisfaction of urban parks in Ankara and Jakarta. As the scores given to the access criteria increased, the satisfaction scores of the urban parks increased at the same level. While there is a strong correlation between the "facility" criterion and the satisfaction of the parks in Ankara, it is seen that the parks in Jakarta do not affect the satisfaction scores at a statistically significant level. There is a strong correlation between the "safety" criterion and the satisfaction scores of the parks in both cities. The fact that there were no problems in the parks in terms of security positively affected the satisfaction levels. Likewise, there is a strong correlation between the "usability" criterion and satisfaction scores of the parks in Ankara and Jakarta. Having potential areas of use in parks has been an important factor that ensures high levels of satisfaction. While the "threats" criterion strongly affected the satisfaction scores of the parks in Ankara, it did not affect the satisfaction scores of the parks in Jakarta statistically. The parks in Ankara did not pose any threat, which enabled their satisfaction ratings to increase.

Table 6. Correlation analysis between NEST criteria and satisfaction levels

NEST CRITERIAS			SATISFACTION
Environment	Ankara	Pearson Correlation	-,168
		Sig. (2-tailed)	,057
	Jakarta	Pearson Correlation	,078
		Sig. (2-tailed)	,379
Access	Ankara	Pearson Correlation	**,727****
		Sig. (2-tailed)	**,000**
	Jakarta	Pearson Correlation	**,306***
		Sig. (2-tailed)	**,003**
Facility	Ankara	Pearson Correlation	**,631****
		Sig. (2-tailed)	**,008**
	Jakarta	Pearson Correlation	-,156
		Sig. (2-tailed)	,077
Aesthetics	Ankara	Pearson Correlation	**,357***
		Sig. (2-tailed)	**,027**
	Jakarta	Pearson Correlation	**,439****
		Sig. (2-tailed)	**,006**
Safety	Ankara	Pearson Correlation	**,422****
		Sig. (2-tailed)	**,000**
	Jakarta	Pearson Correlation	**,277****
		Sig. (2-tailed)	**,001**
Threats	Ankara	Pearson Correlation	**,284****
		Sig. (2-tailed)	**,001**
	Jakarta	Pearson Correlation	-,013
		Sig. (2-tailed)	,879
Usability	Ankara	Pearson Correlation	**,545****
		Sig. (2-tailed)	**,000**
	Jakarta	Pearson Correlation	-,013
		Sig. (2-tailed)	,879

***. Correlation is significant at the 0.01 level (2-tailed).*
**. Correlation is significant at the 0.05 level (2-tailed).*
r = 0.10-0.29(weak)
r = 0.30-0.49(medium)
r = > 0.50(strong)

4. Result and Discussion

Urban parks play a key role in ensuring sustainable urban development. The use of parks by users is also important for urban planning and the development of green space infrastructure. In this context, the high satisfaction level of the users with the park spaces is important not only for the design and planning of the urban parks, but also for the parks to continue their functions in a healthy way. As a result of the determination of user satisfaction, it will be possible to make parks more attractive for city residents and to develop new strategies by identifying their deficiencies and insufficient situations.

In the study, the parks selected as study areas from Ankara and Jakarta by using NEST were compared and evaluated. In the results of the study, the users stated that they came with their families while coming to Altinpark, Harikalar Diyari in Ankara and Monas Park in Jakarta, while they stated that they came to Jakarta Menteng Park with their friends. There was no significant difference between the park areas of both cities considering with whom the users came. It has been determined that there are differences between cities in the purpose of the users to come to the park. It has been concluded that the purpose of coming to Ankara Altinpark and Harikalar Diyari is a nature excursion, while the purpose of coming to Monas Park is walking, and the purpose of coming to Menteng Park is physical activity. The different purposes of coming to the park areas are closely related to the features and opportunities they have. This result revealed that the users come to the park areas to relax, socialize and satisfy their longing for nature.

This study aimed to determine the relationship between park characteristics and satisfaction levels using the Natural Environment Scoring Tool (NEST) in the study conducted in Ankara and Jakarta sampling areas. In this context, users were asked to rate park areas within the framework of NEST criteria and indicate their level of satisfaction. As a result of the scoring, the satisfaction level of female users was higher than that of men. Likewise, the level of satisfaction of users with a higher level of education was also higher. The high level of satisfaction with the park areas, which are mainly selected from both cities, has been an important result. Within the scope of the study, it was concluded that access, facilities, aesthetics, safety, threats and usability criteria affect the satisfaction of park areas. Adequate entry points, walking, cycling, pedestrian paths and parking areas in the park areas; The availability of facilities such as children's playgrounds, picnic areas in the park areas, the aesthetic plant designs and the usability features areas such as sports, walking and social activities in the park areas have greatly affected the satisfaction levels of the users. At the same time, the fact that these park areas do not contain any threats (alcohol use, drugs, disturbing noise / noise, odor, etc.) and do not pose a problem in terms of security are among the criteria that ensure high satisfaction levels of the users. These results are equivalent to the results of the studies conducted by [39-43]. In addition, [10, 44-46] reached similar results in their studies.

This article, in which the Natural Environment Scoring Tool (NEST) is used, has added a new dimension to the evaluation of park areas. This study emphasized NEST's applicability and set the ground for developing a more comprehensive scoring system by providing its users' participation.

Competing Interest / Conflict of Interest

The authors declare that they have no competing interests.

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Climate Action Plans Under Climate-Resilient Urban Policies

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ABSTRACT

Climate change, which is among the biggest environmental problems of today, affects the lives of all living things economically, socially, and environmentally, both in the city and on a global scale. Especially in the climate change process, which has inevitable effects on urban systems and population, action plans come to the fore within the framework of the concepts of climate resilience and vulnerability. Thanks to these plans, mitigation and adaptation policies are produced against negative situations that arise or are predicted to occur in cities. The effects of climate change on each city are different. In this context, it is an important requirement for urban actors to determine their degree of combating the effects of climate change and their adaptation capacities in cooperation.

This study, it was aimed to evaluate successful climate action plans in the world and in Turkey in the process of combating climate change. In this context, first of all, successful climate action plans were determined and examined by literature review. Then, common policies and strategies were determined and suggestions were developed to prepare the ground for the climate change struggle processes of other cities.

Anahtar Kelimeler:
İklim değişikliği,
İklime dirençlilik,
İklim eylem planları,
Azaltım,
Uyum.

ÖZ

Günümüzün en büyük çevre sorunları arasında olan iklim değişikliği hem kent hem de küresel ölçekte ekonomik, sosyal ve çevresel açıdan bütün canlıların yaşamlarını etkilemektedir. Özellikle kentsel sistemler ve nüfus üzerinde kaçınılmaz etkileri olan iklim değişikliği sürecinde, iklime dirençlilik ve kırılganlık kavramları çerçevesinde eylem planları ön plana çıkmaktadır. Bu planlar sayesinde, kentlerde ortaya çıkan veya çıkması öngörülen olumsuz durumlara karşı azaltım ve uyum politikaları üretilmektedir. İklim değişikliğinin her kent üzerinde etkileri farklı olmaktadır. Bu kapsamda kentsel aktörlerin işbirliği içerisinde iklim değişikliğinin etkileri ile mücadele edebilme derecelerini ve uyum kapasitelerini belirlemeleri önemli bir gerekliliktir.

Yapılan bu çalışmada iklim değişikliği ile mücadele sürecinde Dünya'da ve Türkiye'de başarılı iklim eylem planlarını değerlendirmek amaçlanmıştır. Bu bağlamda, ilk olarak literatür taraması yapılarak başarılı iklim eylem planları tespit edilmiş ve irdelenmiştir. Ardından ortak politikalar ve stratejiler belirlenerek diğer kentlerin iklim değişikliği mücadele süreçlerine zemin hazırlamak amacıyla öneriler geliştirilmiştir.

1. Introduction

In recent years, many problems have been emerging in cities, especially as a result of rapid urbanization and population growth, as well as the impact of climate change [1-4]. Environmental pollution and air pollution are the main problems that arise in cities, and these problems also reduce people's quality of life levels [5-11]. In this context,

international concerns are also growing about how to address the effects of climate change on cities [12-14]. It is predicted that climate change will negatively affect the inhabitants of cities, the ecosystem of cities, their physical environment, infrastructure and economy. In line with these growing concerns about the future, it is more effective to see this problem as "creating resilience of cities" rather than focusing on different measures to adapt to climate risks [12].

Resilience is a concept used in many disciplines. The Intergovernmental Panel on Climate Change (IPCC) defines the concept of resilience as "the ability of an ecological or social system to destroy negative situations while maintaining the same basic structure, ways of functioning, the potential to adapt to any situation and change" [15]. The concept of resilience, which is used in many different fields, can be expressed as a response to climatic events and environmental threats, especially in the field of urban and planning [12-16]. In this context, climatic resilience is used to find solutions to the problems caused by climate change and its negative effects within the framework of sustainability [12, 17, 18].

Today, climate change is considered one of the biggest environmental problems in the whole world [19-21]. At the heart of this problem is the beginning of human-caused activities and the phenomenon of urbanization that it brings with it plays an important role. There is a long-standing consensus that carbon emissions produced by humans affect the climate around the world with potentially devastating consequences [22, 23]. According to the Fifth Assessment Report (AR5) published by the Intergovernmental Panel on Climate Change (IPCC) in 2014, urbanization has been evaluated as a global trend worldwide [24]. According to the same report, while 13% of the world's population lived in cities in the 1900s, more than half of the world's population lives in cities today, and by 2050, this rate is expected to be 64-69% [25].

Rapidly growing urban areas are faced with increasing air and water pollution, floods and overflows, heatwaves, and serious climatic risks depending on these conditions [26, 27]. The magnitude of these risks that urban areas face is different for each city and region. Urban population growth, on the other hand, will increase the global greenhouse gas emissions of cities, if necessary precautions are not taken [28, 29]. It is an important requirement to determine how much the cities can be damaged in the face of these dangers and to be prepared for the negative situations that the city and the people living there will experience in the process of combating climate change in the future [20].

The socio-economic and environmental impacts of climate change vary according to the level of development of countries and, most importantly, the level of vulnerability of cities. Therefore, it is of great importance to determine the issues such as which climate change risks all cities face or will face on a local scale, the situation of producing greenhouse gases due to the morphological characteristics of cities, and the strength of resistance to climate change are of great importance. In the process of combating climate change, "reduction and adaptation" policies come to the fore. Especially in recent years, the integration of mitigation and adaptation policies with urban planning to build cities that are more resilient to the risks of climate change, and accordingly, the necessity of land use planning that will support adaptation to the effects and threats of climate change are among the important issues [30].

Reduction; It is expressed as the work done to minimize the speed and size of greenhouse gas emissions as a result of human-induced activities [31, 32]. Rapport; Coping with the situations caused by climate change is explained as minimizing the climate impact with regulations in ecological, economic, and social areas [31, 33]. While the results of human-based activities come to the forefront in mitigation studies and the effects of these situations are in question, there is a holism in harmonization studies. Therefore, the most effective method of combating the negative effects of climate change on a global scale is adaptation studies. Solution methods determined within the scope of harmonization studies at a local scale are more likely to be effective since all segments of the society are approached holistically [33]. In the last 20 years, there has been a rapid increase in the development of adaptation policies in the fight against climate change worldwide [34, 35]. In the implementation of these policies, there is very little consensus on which ones are counted as effective adaptation processes. The most important reason for this situation is that policies and initiatives are proposed and planned but rarely implemented [36].

Responding to climate change is seen as the greatest environmental and economic challenge of our time. In the stage of finding a solution to this difficulty, it is an important problem that there are major deficiencies in the implementation of policies. The main reason for this problem is that practitioners do not clearly understand what works and what does not work [23]. Although various studies have been carried out to combat climate change on an international and national scale, the desired level has not been reached [21]. In this context, the issue of what cities can do against the

problem of climate change is being discussed. The World Bank declared the problem of climate change as an "urgent agenda item" during this struggle [37]. With the effect of rapid urbanization and climate change, the increasing pressure in urban areas causes an increase in environmental problems [3, 38-42]. In this context, within the scope of the study, the successful projects in the fight against climate change in the world and in Turkey, have been compared and suggestions have been developed.

1.1 Climate Change Fighting Process in the World

The process of combating climate change on an international scale has been on the world agenda since the 1970s. The most important application made in this process is the "UN Framework Convention on Climate Change (UNFCCC)", which was adopted by the United Nations (UN) at the Rio Conference in 1992. The Convention aims to reduce greenhouse gas emissions, which are the causes of climate change. The Kyoto Protocol, which was accepted in 1997, brought binding emission reduction or limitation commitments to the EU and industrialized countries, which are responsible for greenhouse gas emissions [43].

In 1990, the "Local Governments for Sustainability (ICLEI)" community was established in New York. This official community, which was established, accelerated the process for the implementation of the "Cities for Climate Protection" project in 1993. ICLEI has proposed a 5-stage process model for cities to implement a successful climate policy at the local scale (Table 1) [37].

Table 1. Process model proposed by ICLEI for climate policy

MITIGATION	ADAPTATION
1. Establishing and estimating a reference emissions inventory	1. Identifying the effects of climate change (evaluating vulnerability, opportunity and resilience)
2. To set an emission reduction target for the forecast year.	2. Identify relevant compliance strategies
3. Developing a local action plan	3. Identifying priority action areas and developing a local action plan
4. Implementing policies and measures	4. Implementing policies, system improvements and compliance measures
5. Monitoring, verifying and reporting results	5. Monitoring, evaluating and reporting results

Sample plans that have been successful in combating climate change on a local scale around the world are given in Table 2.

Table 2. Successful climate action plans in the World

PLAN	PLAN CONTENT	PLAN TARGETS
Portland Climate Action Plan, 1993	Energy-saving	◗ Carbon dioxide emission reduction ◗ Ensuring energy savings for the municipality
Freiburg Climate Protection Plicy, 2007	Climate change awareness and energy savings	◗ Greenhouse gas emission reduction
Seattle Climate Action Plan, 2013	Energy-saving	◗ Fuel-saving ◗ Energy efficiency in buildings ◗ Greenhouse gas emission reduction
Pennsylvania Climate Action Plan, 2018	Energy-saving	• Energy-saving • Greenhouse gas emission reduction

Portland (USA, Oregon State) is one of the municipalities that highlighted the energy-saving potential in public buildings in the fight against climate change between 1990 and 2000, and thus will be listed among the important examples in the struggle process [37-44-45]. Portland prepared its climate action plan in 1993. The goals of the plan

include reducing carbon dioxide emissions (115,000 tons in 10 years) as well as providing energy savings ($9.6 million) to the local government [46].

The city of Freiburg (Germany) succeeded to be one of the greenest cities in Europe in 1996, thanks to its clean energy policies and the work it has done in this direction. The local government in the city has halved the share of nuclear electricity since 1996, ensuring that approximately 50% of the city's electricity and heating needs are met from power plants and combined heat [45, 47]. Today, the city of Freiburg aims to reduce greenhouse gas emissions (40%) by 2030. At the same time, the Freiburg local government has a successful initiative called the "Carbon Dioxide Diet Program (CO2 Diet Programme)", which aims to increase the awareness of the public in the fight against climate change [48].

With the "Kyoto Movement" initiated by the Seattle Municipality (USA, Washington State) in the United States, a large number of mayors signed the "Climate Protection Agreement". In this way, municipalities have put into effect the emission reduction targets required by the Kyoto Protocol in their cities and accelerated the process for governments to take action. In the process, the "Climate Protection Center" was established with the cooperation of municipalities. This center has been a guide for local governments to take appropriate steps for the use of renewable energy sources in all buildings in cities, starting with green building, green transportation, and energy-saving practices, especially climate programs, and buildings belonging to official institutions [45-49]. During this period when local governments were active in climate change, a city climate action plan was prepared by the City of Seattle. Within the scope of the plan, projects such as the establishment of a "Green Building Special Team" were implemented in order to save fuel (40%) in the city center and save energy in buildings (20%) with electric vehicles. The main goal of the Seattle Climate Action Plan is to reduce the city's 1990 level greenhouse gas emissions by 7% by 2012. This target was achieved in 2005. The Seattle local government, which is still determined in the fight against climate change, has set a long-term goal in 2011 for the people to adopt a "zero-carbon lifestyle" by 2050. In order to achieve this goal, the Seattle Climate Action Plan was revised and prepared again in 2013. Within the scope of the plan, strategies for reducing greenhouse gas emissions in the city and adapting to the effects of climate change, including social policies, were determined. Most of the targets in the plan were achieved before 2015 [50].

Another city that has been successful in the process of combating climate change is Pennsylvania. The "Climate Change Act" was signed into law by the local government of Pennsylvania in 2008. After the law was adopted, an Advisory Committee on Climate Change was established to prepare a plan to reduce greenhouse gas emissions in the region. In the plan, mitigation strategies have been determined in many areas. Improvements have been made in energy efficiency, especially in reducing greenhouse gas emissions. The plan also aims to achieve economic savings [51].

1.2 Climate Change Fighting Process in Turkey

In the process of combating climate change, Turkey also joined the Framework Convention on Climate Change in 2004 and the Kyoto Protocol as a party in 2009 without binding reduction obligations. Processes of climate change action plans on a local scale began in the 2000s [37]. The successful plans made in the process of combating climate change on a local scale in Turkey are given in Table 3.

Table 3. Successful climate action plans in Turkey

PLAN	PLAN CONTENT	PLAN TARGETS
Gaziantep Climate Action Plan, 2011	Energy sector	• Carbon reduction • Establishing a climate change institution in the city • Promoting and supporting low-carbon Technologies in economic sectors
İstanbul Climate Action Plan, 2018	Carbon reduction	• Making low emission projects • Establishment of carbon market at local scales • Targets on how the city can concretely reduce its climatic vulnerability and reduce the city's emissions. • During the process, it was aimed to carry out important studies that are the basis for Istanbul's climate action plan and the source of the main plan.
Bursa Climate Action Plan, 2017	Sustainable energy and adaptation to climate change	• Conducting vulnerability analysis on various thematic issues at city scale • After these analyzes, strategies and actions are determined.

Kocaeli Climate Action Plan, 2018	Energy-saving	• Greenhouse gas emission reduction. • Final reduction targets according to the Greenhouse Gas Inventory

Gaziantep is the first Metropolitan city in Turkey to prepare a local Climate Change Action Plan [45-52]. The plan, which is focused on the energy sector, is an important exemplary initiative in terms of local implementation of Turkey's National Action Plan on Climate Change and the Climate Change Strategy Document. The carbon reduction target (15%) announced in the plan for 2023 is the first reduction target set on a local scale in Turkey [53].

In 2015, the greenhouse gas inventory of electricity, natural gas, transportation, waste, and other fuels in Istanbul was renewed. In the period between 2015-2018, necessary steps were taken for the "Istanbul Climate Change Action Plan". The basic elements of the plan, which can evaluate risks and opportunities related to climate and support capacity-building activities and participation of stakeholders, within the framework of climate change "mitigation" and "adaptation" principles, have been completed within the cooperation of Istanbul Environmental Management Industry and Trade Inc. and Istanbul Metropolitan Municipality [45-54]. The plan includes strategies and targets for low-emission projects, the creation of local carbon markets, and how to reduce the city's vulnerability to the effects of climate change in the long term (Istanbul Climate Action Plan, 2018).

Bursa's climate change plan includes sustainable energy strategies as well as climate change adaptation strategies. In this respect, the plan is among the important climate action plans in Turkey as an integrated climate action plan model. The part of the plan that includes the climate change adaptation strategies was prepared in cooperation with the “European Environment Agency” [45-54]. In the plan, there are strategies and targets made in this direction by making vulnerability analyzes on many thematic issues such as the urban heat island effect, urban water areas, green areas in terms of physical planning at the urban scale [56].

Kocaeli Climate Change Action Plan was completed in 2018 within the scope of a project financed from EU grant funds [33-45]. The plan is based on 2 basic reports as “Climate Change Action Plan and Greenhouse Gas Inventory”. In the emission-oriented plan, it is aimed to reduce greenhouse gas emissions [57].

3. Conclusion and Suggestions

The borderless nature of environmental problems, which is one of the important components of the agenda at the summit meetings, poses a great threat both for cities and for humanity. The problems, which have been increasing since the past, started to be felt more intensely after the industrial revolution. Recently, environmental problems such as global warming and climate change are problems that require international cooperation in order to meet the needs of future generations. In the study, successful plans in the fight against climate change in the world and in Turkey were examined. In this context, it has been determined that an approach focused on “reduction” is at the forefront of climate action plans. Cities have adopted measures to reduce the amount of greenhouse gas emissions, especially within the framework of the principle of energy efficiency. The most important aim of all these plans is to create “climate-friendly resilient cities”. Considering the plans examined within the scope of the study, the suggestions developed for cities to be successful in the fight against climate change on a local scale are as follows:

- Despite the efforts of the UN especially after 1990, the measures taken by the states did not contribute to limiting the negative consequences of climate change or reducing it to the level that scientists consider safe. Therefore, there is a need for more international cooperation and transparent information sharing in the following processes.

- Sensitivity to climate change is quite high, especially in developing cities, where there is rapid and unplanned urbanization, and where the quality of life of the urban population is not high. These cities need to be prepared and resilient in order to reduce the risks against the negative consequences of climate change and to ensure the health, quality of life, and safety of people.

- In the process of combating climate change on a local scale, it is seen that mitigation policies are emphasized all over the world. In the reduction policies, areas such as transportation, energy, wasteland use, and urban planning come to the fore. Among these areas, the sector that cities prioritize is the energy sector. “Energy efficiency (reducing carbon dioxide emissions)”, which is prominent in most of the plans examined, is important both in terms of climate change policies and in terms of reducing energy costs. In this context, public vehicles in urban transportation sectors should be renewed and developed according to energy efficiency. Emphasis should be placed on policies and designs that encourage and enable walking and cycling.

- In local waste policies, measures such as reuse and recycling of waste come to the fore. In the field of urban planning, standards suitable for energy efficiency should be developed, especially for new buildings and neighborhoods to be established.

- Adaptation policies at the local scale are relatively new in the fight against climate change. In addition to the planning approach used in reduction policies based on carbon emission reduction, integrated adaptation policies should be produced by considering the current trend of the world.

- It is an important requirement to create risk action plans and create risk maps within the framework of climate change forecasts and predictions for cities. It is necessary to consider climate resilience in the plans and studies and to develop plan decisions for reducing or balancing greenhouse gas emissions

- For cities in the world and Turkey to gain resilience and adapt to unexpected developments arising from climate change, it is necessary to ensure that fragile areas (industry, housing, etc.), sectors (industry, energy, transportation, etc.), and values (natural and cultural values) are comprehensively evaluated. Compliance plans should be prepared by making analyzes in a way. In these plans, holistic plan decisions should be taken by considering transportation, infrastructure, and access to services, water management, drought risk management, food safety, and public health issues.

Possible developments to be made in the next process in the fight against global climate change should be followed up and analyses should be widespread. In this process, all countries, especially developed countries, should take responsibility for climate change. Local governments in Turkey have significant potential in terms of mitigation and adaptation measures. With renewable energy, energy efficiency, waste management, transportation, and urban planning powers, local governments stand out in the goal of climate resilience in Turkey. In the decisions to be made in this context, sustainability-based principles should be determined using a human and ecology-oriented approach, resource values should be used effectively, and stakeholders producing information should be supported.

Competing Interest / Conflict of Interest
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Changes of Calcium Content on Some Trees in Kocaeli

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ABSTRACT

Soil is an essential component for the lives of plants, as well as water and air are. The elements in the soil direct the metabolic activities such as beginning, formation, and continuity of life. The level of nutrient elements in the body determines the status of vital activities. The amount of nutrient elements in soil and the mechanism of plants' intake of these elements vary between the species. Calcium (Ca), one of the main macronutrient elements, is of vital importance for many vital functions such as cell wall and membrane for plants and trees, but its deficiency results in developmental losses, yield losses, stress, and even death. In fact, under the effect of mutual interaction between genetic factors and environmental factors, it accumulates within the species at different levels. In this study, the species used for determining the amount of the Ca were obtained from an industrial zone in Kocaeli province in the year 2020. The annual rings of *Robinia pseudoacacia*, *Cupressus arizonica*, and *Platanus orientalis* were used during the analyses. Thanks to the multiple annual rings of these trees, the variability of the Ca concentrations could be determined by years.

Anahtar Kelimeler:
Yıllık halkalar,
Kalsiyum,
biriktirme,
Besin öğesi,
Ağaçlar.

ÖZ

Toprak, su ve hava gibi bitkilerin yaşamını devam ettirmesinde vazgeçilmez unsurdur. Toprak içindeki elementler ise yaşamın başlaması, oluşumu ve sürdürülmesi gibi metabolic faliyetlere yön vermektedir. Özellikle de besin elementlerinin hangi düzeyde bünyede bulunması ile yaşamsal aktivitelerinin durumlarını belirlemektedir. Topraktaki besin elementlerinin miktarı ve bitkilerin bunları bünyelerine almalarındaki mekanizması herbir tür için değişkenlik göstermektedir. Makro besin elementlerinin başında yer alan Kalsiyum (Ca) elementi bitkiler ve ağaçlar için hücre duvarı ve zar işlevi gibi oldukça hayati öneme sahip olmasına ragmen eksikliği ise bünyede olumsuz bir şekilde gelişim kayıplarına, ürün zayıflığına, strese hatta ölümle sonuçlanmaktadır. Esasında genetik faktörler ile çevresel faktörlerin karşılıklı etkileşimi altında türlerde farklı düzeylerde birikim yapmaktadır. Çalışma kapsamında Ca miktarlarının tespiti için kullanılan türlerin 2020 yılının sonunda Kocaeli iline ait sanayi bölgesinden temin edilmiştir. Bunlar sırasıyla *Robinia pseudoacacia, Cupressus arizonica* ve *Platanus orientalis* ağaçlarının yıllık halkalarından faydalanılmıştır. Bu ağaçların çok yıllık halkaları sayesinde Ca besin elementinin yıllara göre konsantrasyonlarının değişkenlikleri tespit edilmiştir.

1. Introduction

As a result of the rapid increase in world population, the problems such as unplanned urbanization, uncontrolled industrialization, out-of-purpose and unconscious use of agricultural lands, and gradual increase in the agricultural pesticides constantly decrease the fertile soils, which can be used for agricultural purposes [1-3]. Hence, various

measures should be taken in order to protect these areas and make the best of them. Soil can be protected and sustained only by keeping its fertility optimized [4-6].

Sustainable use of soils, knowing the physical and chemical properties, and managing them in accordance with these properties are very important [7]. The nutrient materials should be present in the habitats of plants at appropriate concentrations and enough amounts. Deficiency and abundance of necessary nutrients negatively affect the plant development and their capacity to benefit from nutrient elements in soil and, consequently, it negatively affects the yield and quality [8]. Plant productivity and quality of soil, which supports the ecosystem services, directly depend on the deficiency or abundance of nutrient materials [9]. In addition, since the chemical and physical properties of the soil are well-known in sustainable agriculture, optimum benefit can be obtained from the fertilization process [10]. For this purpose, many studies were carried out in order to determine the productivity levels of different regions and soils and to foreknow the potential nutrition problems [11]. Calcium (Ca), which is an important macronutrient, has vital importance for plants and trees and is a dynamic molecule used in transmitting the signals between tissues of plants [12]. The Ca concentrations of soils vary between 4587 ppm and 8157 ppm at the depth of 0-30 cm and between 4688 ppm and 8413 ppm at the depth of 30-60 cm [13]. Ca concentrations between 3500 and 10000 ppm are considered as high and those higher than 10000 ppm are considered as very high [14]. The Ca is very mobile in the soil and it may accumulate on the surface of roots because of the mass flow [15]. However, high levels of Ca cause an increase in pH, surface minerals, aggregation, organic matter stabilization, and ample amount of worms [16]. In studies carried out on the intake of Ca in trees, it was observed that the concentrations of Ca varied between the biomasses of trees [17, 18]. Moreover, it was determined in other studies that Ca concentration increasing for 30 years caused an increase in acidity in soil and a decrease in productivity of species [19]. Since the mobility of Ca in phloem is limited, low amount of Ca is absorbed during the aging of leaves [20]. When compared to the old ones, young leaves absorb very higher amounts of Ca. In some study, reported an inverse proportion between heavy metals and Ca element [21, 22]. If the concentration of heavy metals in soil increases, then the decrease in Ca concentration causes a decrease in the intake by wood and other organs. If the Ca concentration increases in soil, then the intake of heavy metals decreases [23].

After various problems and uncertainties about the use of plants as biomonitors, studies reported that trees can also be used as biomonitors [24-28]. The most accurate information can be obtained by making use of needle-leaved trees such as pine, spruce, and fir, which have their needle-leaves on them for a long time and leaf-age of which can be clearly determined. In this method, max 10 years of data can be achieved. However, when using the annual rings, the data of longer periods can be achieved. In regions, where four seasons are seen, the development of trees was found to occur at different levels. The annual rings form in wood parts of these trees. With nutrients accumulating in annual rings, they provide important information about the history of tree [29]. The annual rings of trees increase with the age of the tree and there are trees that can live up to thousands of years. The annual rings of trees can be used as an indicator of pollution and they can provide important information about the distribution and chronology of nutrients at the location, where the tree is grown. The studies on usability of annual rings as biomonitor and the knowledge about the transfer of nutrient elements within their organisms are very limited [30].

In the present study, the calcium element was examined in terms of the years in annual rings. Within the scope of this study, the Ca concentrations in the annual rings of 3 different trees growing in an intense industrial zone in Kocaeli province were examined by years and organs. The trees used for this purpose were *Robinia pseudoacacia*, *Cupressus arizonica*, and *Platanus orientalis*. The concentrations of the Ca in outer bark, inner bark, and wood fractions of trees were analyzed. It was aimed to determine how the Ca concentration in the annual rings of trees changed by year and if these annual changes were similar.

2. Material and Method

This study was used with locust tree (*Robinia pseudoacacia* L.), arizona cypress (*Cupressus arizonica* G.) and eastern sycamore (*Platanus orientalis* L.). All samples were taken from the main trunk of the organized industrial zone (OSB) of Kocaeli city at December, 2020. A 10 cm thick log sample was taken from the trees from a height of 50 cm from the ground, by marking the north direction on the log. The annual rings of *Robinia pseudoacacia*, *Cupressus arizonica* and *Platanus orientalis* were determined to be 30 years old, have come from 1991-1993 to 2018-2020 in a three-year period (taking into account their widths). The wood surface was divided into groups for the age ranges. Also they were determined the outer bark, inner bark and wood of all ages. The wood samples taken are brought to the 1-2 cm interval without using metal. Samples taken into glass containers are kept at room temperature with their mouths open for 12 days, and then they are oven-dried at 55 ºC for 60 hours. The samples were taken as 0.5 g weighed and 5 ml

of 65% HNO_3 and 2 ml of 30% H_2O_2 were added. The combustion process was carried out in the microwave oven at 200 ºC for 15 minutes. The resulting samples were made up to 50 ml with ultrapure water and Ca analyzes were made in the by atomic emission spectrometry (ICP-OES) with a plasma source device (SpectroBlue, Spectro). In the study, all measurements are repeated in triplicate and the obtained data are analyzed by using the SPSS 22.0 package program, analysis of variance and Duncan test.

3. Results

The biomonitor chosen was the bark and organ of a *Robinia pseudoacacia*, *Cupressus arizonica* and *Platanus orientalis* which, due to its widely used and readily available. It has been proven that it can provide information on the presence of Ca element on the organ in Table 1.

Table 1. Change of Ca concentrations (ppm) based on species

Organ	Species			F value
	Robinia pseudoacacia	*Cupressus arizonica*	*Platanus orientalis*	
Wood	2790.4 Ba	1257.4 Aa	3753.6 Ca	32.9***
Inner Bark	8105.6 Bb	8025.7 Bc	8097.5 Ab	51.5***
Outer Bark	5636.2 Ab	5698.8 Ab	8105.7 Bb	1156.5***
F value	13.3***	2541.8***	156.3***	

Statistically significant *** $p<0.001$

According to the results of variance analysis (ANOVA) that the change in the concentration of Ca element on organ basis in all three species is statistically significant ($p<0.001$). The Duncan test results that the values obtained in wood in all species were in the first group, while the values obtained in the outer bark were in the second group. However, the values obtained in the inner bark were in the second group in *Robinia pseudoacacia* and *Platanus orientalis*, and in the third group in *Cupressus arizonica*.

According to these results, it can be said that the Ca concentration is ranked as wood<outer bark<inner bark. The lowest value in the outer bark is obtained in *Robinia pseudoacacia* with 5636.2 ppm, the highest value is obtained in *Platanus orientalis* with 8105.7 ppm, the highest value in the inner bark is obtained in *Robinia pseudoacacia* with 8105.6 ppm, and the lowest value is obtained in *Cupressus arizonica* with 8025.7 ppm. In the wood part, the lowest value is obtained in *Cupressus arizonica* with 1257.4 ppm, and the highest value is obtained in *Platanus orientalis* with 3753.6 ppm. According to these results, it can be said that the lowest values are obtained in *Cupressus arizonica* and the highest values are obtained in *Platanus orientalis*. The change in the Ca concentration in woods depending on the age range and direction is given in Table 2.

Table 2. The Ca concentration (ppm) age interval and species change of in wood

Range of age	Species			F value
	Robinia pseudoacacia	*Cupressus arizonica*	*Platanus orientalis*	
2018-2020	1532 Bc	898.9 Aa	4434 Ch	179***
2015-2017	2737.8 Be	1039.5 Ab	2914.4 Ca	16280.9***
2012-2014	3147.2 Bg	1116.6 Ac	3830.8 Cf	1248.5***
2009-2011	3004.3 Bf	1318.4 Ae	4222.6 Cg	121256.5***
2006-2008	2437.9 Bd	1480.8 Ah	3867.8 Cf	167844.7***
2003-2005	6149.9 Ch	1363 Afg	3218.1 Bb	41708***
2000-2002	6434.6 Ci	1146.2 Ad	3493.4 Be	223201.3***
1997-1999	686.5 Aa	1346.8 Bf	4859.4 Ci	396930.2***
1994-1996	881.5 Ab	1379.4 Bg	3291.2 Cc	57430.1***
1991-1993	892.2 Ab	1484.5 Bh	3404.8 Cd	23315***
F value	21513.9***	626.7***	1110.5***	

Statistically significant *** $p<0.001$

When the values showing the change of Ca element according to the age range are examined, it is seen that the highest value in *Robinia pseudoacacia* is obtained with 6434.6 ppm in 2000-2002, the lowest value with 686.5 ppm in 1997-1999, the lowest value in *Cupressus arizonica* in 2018-2020 with 898.,9 ppm, the highest value is obtained in the years 1991-1993 with 1484.5 ppm, the highest value in *Platanus orientalis* with 4434 ppm in the years 2018-2020, and the lowest value with 2914.4 ppm in the years 2015-2017. According to the analysis of variance results, it is determined that the variation of Ca concentration depending on the species is statistically significant at least 99.9% confidence level (p<0.001) in all age ranges. When the values are examined, it is very difficult to say that the Ca concentration changes regularly on the basis of species or year. This situation can be interpreted as the change of Ca concentration in plants does not change primarily depending on the species or year, and other factors are more dominant.

4. Discussion

Within the scope of this study, changes of Ca concentrations in outer bark, inner bark, and wood of *Robinia pseudoacacia*, *Cupressus arizonica*, and *Platanus orientalis* trees by year and organ were examined. Investigated in this study, Ca is a macronutrient element that is a necessity for the development and growth of plants and it plays important roles in cell growth and development, adjustment of membrane permeability, tissue stabilization, and quality of plants. Ca is of vital importance for fauna, microflora, plant, and soil. It has significant effects on the physical and chemical properties of the soil. It is of significant importance for the functional and structural characteristics of plant cell plasma membranes and its deficiency results in yield and quality losses in plants [31]. Hence, the studies examining the intake and accumulation of Ca in the plant body are very important.

At the end of this study, it was determined that the concentration of Ca significantly changed between wood, inner bark, and outer barks within the species and between species by organ. For instance, Ca concentration found to be 1257.4ppm in wood of *Cupressus arizonica* was determined to be 8025.7ppm in inner bark of *Cupressus arizonica* and 37.53.6ppm in wood of *Platanus orientalis*. It suggests that Ca concentration can vary significantly between the organs of a species or between the same organs of different species. Similar results were reported in the studies examining the element concentrations of plant organs. In these studies, it was determined that the concentrations of many macro and micronutrient elements significantly varied between different organs of a single species [32-34] and between the same organs of different species [35, 36]. This is because the intake and accumulation of elements in plant body occur through a complex mechanism. This process is closely related with the organ of plant and the structure of element [37]. The main factor influencing the element accumulation in plants is the plant metabolism [38, 39]. Hence, remarkably influencing the plant metabolism, many factors including stress level of plant, plant's genetic structure, environmental factors affect the element intake and accumulation [40-43].

One of the most important factors causing different levels of element accumulation in different organs of a single species is the structure of organ [44]. While the element intake can occur via air through the stoma opening in leaves, the element concentrations might reach much higher levels in outer bark because of the retention of particles contaminated by various elements [45]. Thus, when washed, the contaminated particles are removed from the organs and the concentrations of relevant elements can significantly change. Besides that, it was also determined that the concentrations of elements in inner bark and wood, which have no direct contact with outer environment, can be much lower than in the outer bark [46-48]. The results showed that Ca concentrations can significantly vary between the woods forming in a single tree during the subsequent years. For instance, Ca concentration of the wood of *Robinia pseudoacacia* forming in the period 1997-1999 was found to be 686.5 ppm, whereas the concentration in woods forming in the period 2000-2002 was found to be 6434.6 ppm. This finding proves that the transfer of Ca element within the wood is limited. Comparing the species examined here, it was determined that the highest change was observed in *Robinia pseudoacacia*. This finding showed that the most suitable species to be used in monitoring the change of Ca concentration by year is *Robinia pseudoacacia*.

Competing Interest / Conflict of Interest

The authors declare that they have no competing interests.

Author contribution

We declare that all Authors equally contribute.

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Investigation of Bioclimatic Comfort Structure in Muğla with the help of Geographical Information Systems

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ABSTRACT

In places and times where the climate is not comfortable for people, people have adapted their clothing habits according to the situation and developed heating and cooling systems in their buildings and cars. On the other hand, until the last century, research on climate comfort remained in the form of philosophical description rather than experimentation. The studies in the last century, on the other hand, remained mostly local, seasonal/spatial continuity and difference have just begun to take their place in the literature. This deficiency in the literature creates an obligation for academics interested in the subject to work on this subject and produce examples. It is aimed to determine the areas where climate comfort is suitable or not for human life and activities in Muğla province and its surroundings. For this purpose, climate data for the period 1975-2017 of 9 meteorology stations were obtained from the MGM in the province. These stations were digitized transferred in the CBS environment using by GIS. The transferred data were interpolated with the Co-Kriging method using the seasonal elevation factor. Thus, temperature and humidity substrates were obtained. By calculating Thom's temperature-humidity index with raster data created by interpolation, seasonal and spatially continuous felt temperature values were produced. The calculated values were classified according to the Temperature Equivalent Psychology scale and the seasonal and spatial determination of the climate comfort. The relationship between climate comfort and land cover/classes was determined.

Anahtar Kelimeler:
Biyoklimatik Konfor,
CBS,
Co-Kriging,
Hissedilen Sıcaklık,
Muğla.

ÖZ

İklimin insanlar için konforlu olmadığı yerlerde ve zamanlarda insanlar giyim alışkanlıklarını duruma göre uyarlamışlar ayrıca binalarında ve arabalarında ısıtma ve soğutma sistemleri geliştirmişlerdir. Diğer yandan son yüzyıla kadar iklim konforuna yönelik araştırmalar deneysellikten öte felsefi betimleme şeklinde kalmıştır. Son yüzyıldaki çalışmalar ise daha çok lokal özellikte kalmış mevsimsel/mekânsal süreklilik ve farklılık literatürdeki yerini henüz almaya başlamıştır. Literatürdeki bu eksiklik konuyla ilgilenen akademisyenler için bu konuda çalışmalar yapma örnekler üretme zorunluluğu oluşturmaktadır. Bu çalışmada Muğla ili ve çevresinde insan yaşamı ve aktiviteleri için iklim konforunun uygun olduğu ya da olmadığı alanların belirlenmesi amaçlanmıştır. Bu amaç için ildeki MGM'den 9 meteoroloji istasyonuna ait 1975-2017 dönemi iklim verileri (sıcaklık ve nemlilik) elde edilmiştir. Ayrıca bu istasyonlar CBS ortamında sayısallaştırılmıştır. Daha sonra istasyonların iklim verileri Coğrafi Bilgi Sistemleri (CBS) ortamına aktarılmıştır. Aktarılan veriler mevsimsel olarak yükselti faktörü kullanılarak Co-Kriging yöntemiyle enterpole edilmiştir. Böylece sıcaklık ve

nemlilik altlıkları elde edilmiştir. Enterpolasyon ile oluşturulan raster veriler ile Thom'un Sıcaklık-Nemlilik İndisi (DI) hesaplanarak mevsimsel ve mekânsal süreklilik arz eden hissedilen sıcaklık değerleri üretilmiştir. Hesaplanan değerler Sıcaklığa Eşdeğer Psikoloji (SEP) skalasına göre sınıflandırılarak iklim konforunun mevsimsel ve mekânsal olarak belirlenmiştir. Ayrıca iklim konforu ile arazi örtüsü/sınıfları arasındaki ilişki de tespit edilmiştir.

1. Introduction

According to Maslow's hierarchy of needs theory, human needs are ranked according to their priorities. These needs are to eat, drink, sleep, breathe and protect oneself against physical dangers that people have to do to survive. From past to present, people have established settlements in safe areas to protect themselves. In recent years, comfortable areas where climatic conditions are suitable for human life have started to be preferred as residential areas [1-9] For people to continue their lives, they need to establish a heat balance with the environment they live in. To establish this balance, heat exchange takes place between humans and the environment. If the temperature of the environment is higher than the temperature of the human body, the body takes the heat. However, if the body's temperature is too high, it sends heat to the environment with various activities (shivering, sweating, etc.) [10-14]. Thus, people feel comfortable in their environment. If the temperature is 26°C and the relative humidity is above 70%, it cannot give heat to the environment and therefore causes human beings to be under thermal stress [15-19]. Cities with the rapidly increasing population of today's world are among the places where people do not feel comfortable in terms of thermal comfort. Among the main reasons for these are the rapid population growth and the scarcity of green areas in urban areas that are increasing rapidly in an uncontrolled manner. The location of the buildings built in the cities, dense and high buildings, increased traffic density due to overpopulation and air pollution cause warmer environments than the natural areas around the cities. This situation is called an urban heat island [20-26]. To prevent the formation of urban heat islands, it is tried to be eliminated by observing the city-green area relationship in the cities and by designing the settlements by the air currents [27-36].

Since the bioclimatic comfort situation, changes according to time, place, and person, different approaches have emerged. These approaches are the psychological approach, thermophysiological approach, and body temperature balance approach. How the human brain perceives the temperature in the environment in which it lives is a psychological approach. In the thermophysiological approach, the temperature has less effect on the nervous system so that the environment is comfortable. In the last approach, the body temperature balance approach, the heat entering and leaving the body is in balance [37-50]. Two factors, environmental and personal factors, affect human comfort. The first of these are environmental factors: air temperature, humidity, wind, and solar radiation. Personal factors other than environmental factors and resulting from the influence of humans are metabolic heat, activity level, and the wrapping effect of clothing [40-55] In the study, air temperature and relative humidity, which are environmental factors, were taken into account. However, personal factors affecting bioclimatic comfort were not the subject of this study.

This study, it is aimed to determine the bioclimatic comfort status of Muğla province and to reveal its maps. The study was carried out in the following stages. In the first stage, climate data for the years 1975-2017 were obtained from 9 stations from the General Directorate of Meteorology and these data were arranged as monthly averages. The edited climate data was transferred to the Geographic Information Systems (GIS) environment. The temperature and relative humidity data at the stations were made into a continuous surface with the co-kriging model in the GIS environment and disseminated to the area. As a result, pixel-based monthly temperature and relative humidity maps were produced. In the next step, the Temperature-Humidity Index (Discomfort Index) produced by Thom was used. Thus, monthly and average values were obtained on a pixel basis. The classification was made using the Temperature Equivalent Psychology (PET) scale and the felt temperature values were revealed. In the last stage, to examine the relationship between bioclimatic comfort and land use in the province; land classes and annual average felt temperature data were overlapped.

2. Material and Method

2.1 Study area and Data

Muğla province, located in the southwest of Anatolia, is between 36º 07' and 37º 30' north latitudes and 27º 20' and 29º 40' east longitudes [56]. Covering the south of the Menteşe region and the west of the Teke region, the province is surrounded by the Aegean Sea to the west and the Mediterranean Sea to the south (Figure 1a). There are Antalya in the east, Burdur in the northeast, Denizli, and Aydın in the north (Figure 1b).

Temperature and relative humidity data for the years 1975-2017 were obtained from 9 meteorology stations, including Milas, Yatağan, Muğla, Bodrum, Köyceğiz, Marmaris, Dalaman, Fethiye, Datça, located within the borders of Muğla province, from the General Directorate of Meteorology. monthly averages were obtained by arranging the data and transferring it to the GIS environment (Figure 1d).

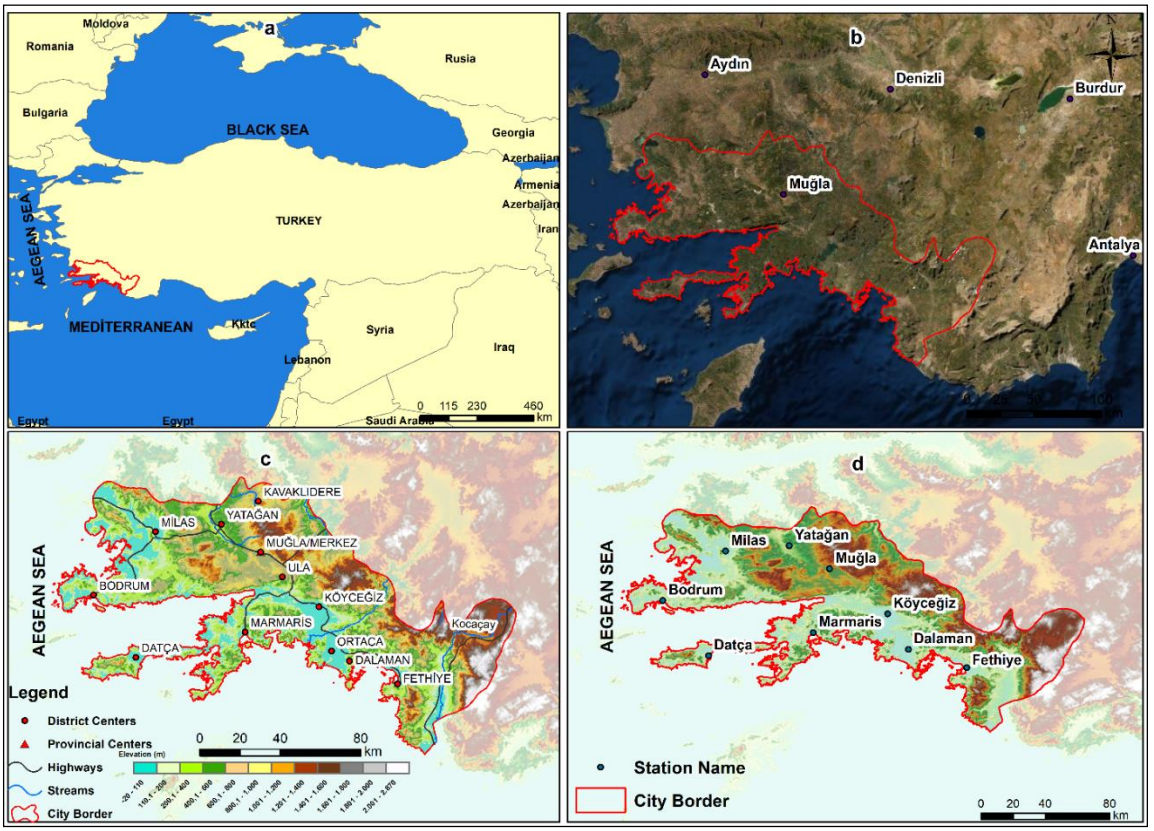

Figure 1. :(a and b= Location, c= Topography of the study area, d= Stations used in the study).

2.2 Method

In the study, the interpolation method was used to obtain continuous surface data from point data. At this stage, pixel-based continuous surface data were created by using the co-kriging technique [5,9,10,14,15, 19, 26,17,24,31,32, 33, 38] , which is one of the interpolation methods of two-dimensional temperature and relative humidity data obtained from MGM stations [57]. Co-kriging method:

$$Z_1(s) = \mu_{1+} \epsilon_1(s)$$

$$Z_2(s) = \mu_{2+} \epsilon_2(s)$$

calculated by the formula.

Here, ϵ_1 and ϵ_2 show random errors, with the unknowns μ_1 and μ_2 fixed. To predict the relationships between variables with the help of other variables, the relationship between them must be strong. There is autocorrelation between Z_1 and Z_2 and co-kriging predicts $Z_1=(s_0)'_1$. [58, 5,9,10,14,15, 19, 26,17,24,31,32, 33, 38]

The Discomfort Indices values based on the temperature and relative humidity relationship produced by Thom on the pixel-based raster data obtained by the co-kriging method were revealed. Index prepared according to temperature and relative humidity;

DI = T – (0,55 – 0,0055 * RH) * (T – 14,5)

Here;

DI=Temperature-Humidity Index (Discomfort Indices)

T=Monthly Average Temperature (C°)

Expressed as RH=Relative Humidity (%) [59, 5,9,10,14,15, 19, 26,17,24,31,32, 33, 38]

With the Discomfort Indices formula, the temperature values felt for 12 months have been produced. However, Physiological Equivalent Temperature (PET) has been adapted to SEP, as DI does not classify climate comfort. Using the SEP classification scheme, it was determined how people perceive temperature (Table 1).

Table 1. Temperature Equivalent Psychology Classification (SEP)

Index Values (DI)	**Thermal comfort classes**
< 4	Very cold
5 – 7.9	Cold
8 – 11.9	Mild cold
12 – 14.9	Cool
15 – 19.9	Comfortable
20 – 21.5	Warm
21.6 – 24.9	Hot
25 >	Very hot

As a result of the index calculations for Muğla province and its surroundings, climate comfort maps were produced following the SEP scheme. It has been revealed how the research area is in terms of thermal comfort for 12 months.

3. Result

3.1 Temperature and Relative Humidity in the Study Area

Temperature data of Muğla province were evaluated using the co-kriging method and monthly average temperature maps were prepared (Figure 2). When the temperature maps obtained were evaluated, it was observed that there were differences according to the months depending on the effect of factors such as temperature values, altitude, proximity, and distance to the sea.

Average monthly temperatures in the study area vary between 5.1°C and 30.1°C. These values are between 5.2°C and 14.1°C in December, January, and February. In January, temperatures are between 6°C - 10°C as you go south from the city center. In February, temperatures in high areas decrease depending on the altitude. While the lowest temperatures prevail in the city center in March, the temperatures reach high values along the coastline. It is seen that the temperature conditions begin to change with April and May. In June, July, and August, the lowest temperatures are seen in the north of the city center with 26°C, while the highest temperatures reach 30°C in places where the altitude is low. When compared to August in terms of average temperature values in September, it is seen that the temperature values decrease. While the temperatures in the east of the province are around 16°C in October, this value drops to 10°C in November.

Since the study area is located by the sea and is exposed to the effect of the maritime, it is seen that there are no extreme winter temperatures in the region, and the temperatures reach maximum values in the spring and summer months. It is observed that changes in climate comfort conditions occur due to the increase in altitude and the emergence of terrestrial conditions as you go from the sea coast to the inner parts. This situation affects people and causes spatial changes.

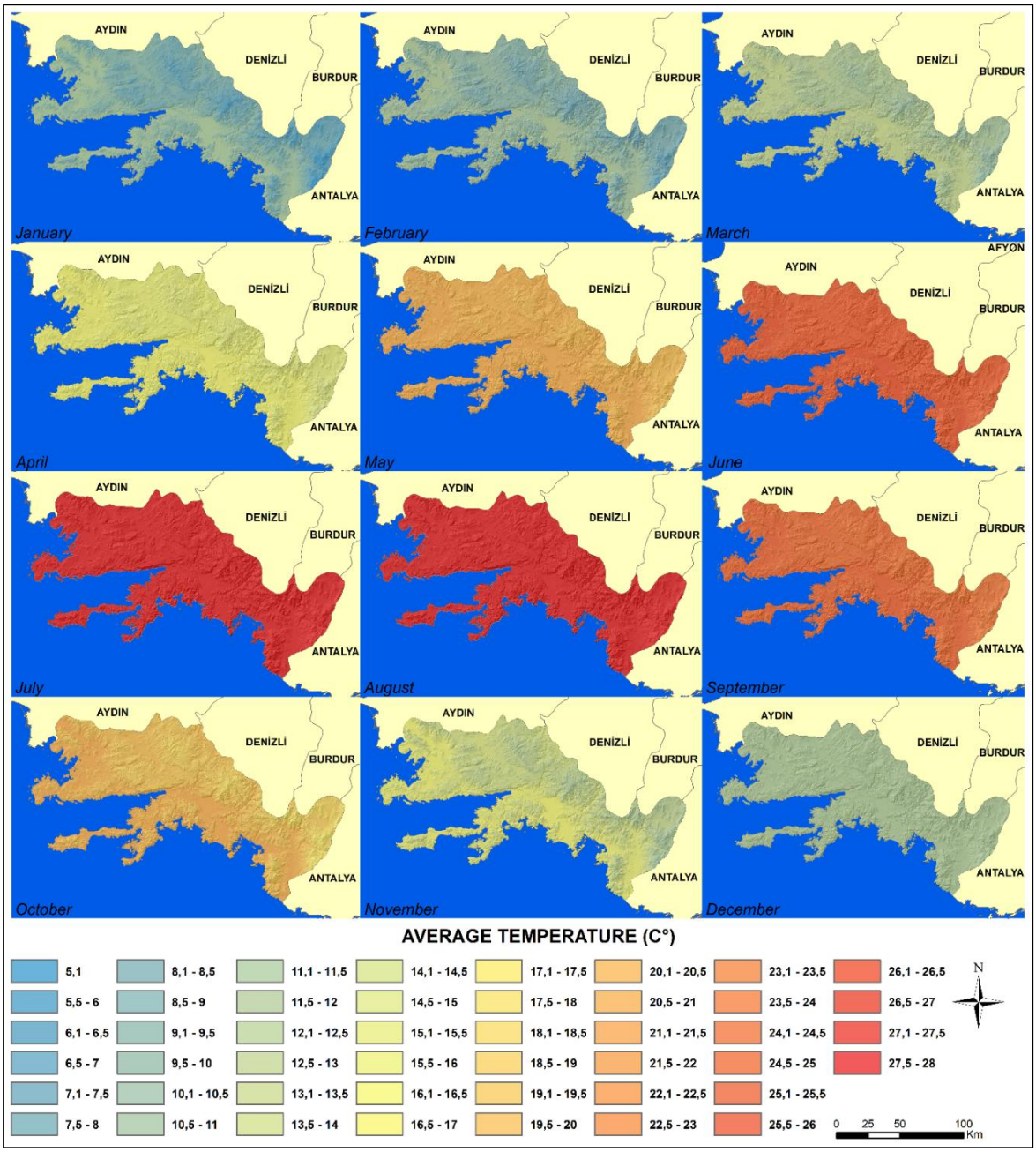

Figure 2: Monthly average temperatures of the study area

When the relative humidity values are examined, it reaches the highest value (79.9%) in the winter months, especially in December. In January, while it is 77% in the city center, the lowest values are seen in the coastal areas. Relative humidity values in February vary between 66% and 73%. When February and March are compared, it is seen that the humidity values are similar. It is observed that the relative humidity values have changed with June. In July, relative humidity values decrease to 52%. In August and September, it reaches 60%. Relative humidity values rise above 70% as of November. Although the relative humidity values rise above 65% in winter (December, January, February), it falls below 60% in summer (June, July, August). In addition, it is observed that the relative humidity is generally low in the coastal areas and the relative humidity values increase in the high areas (Figure 3).

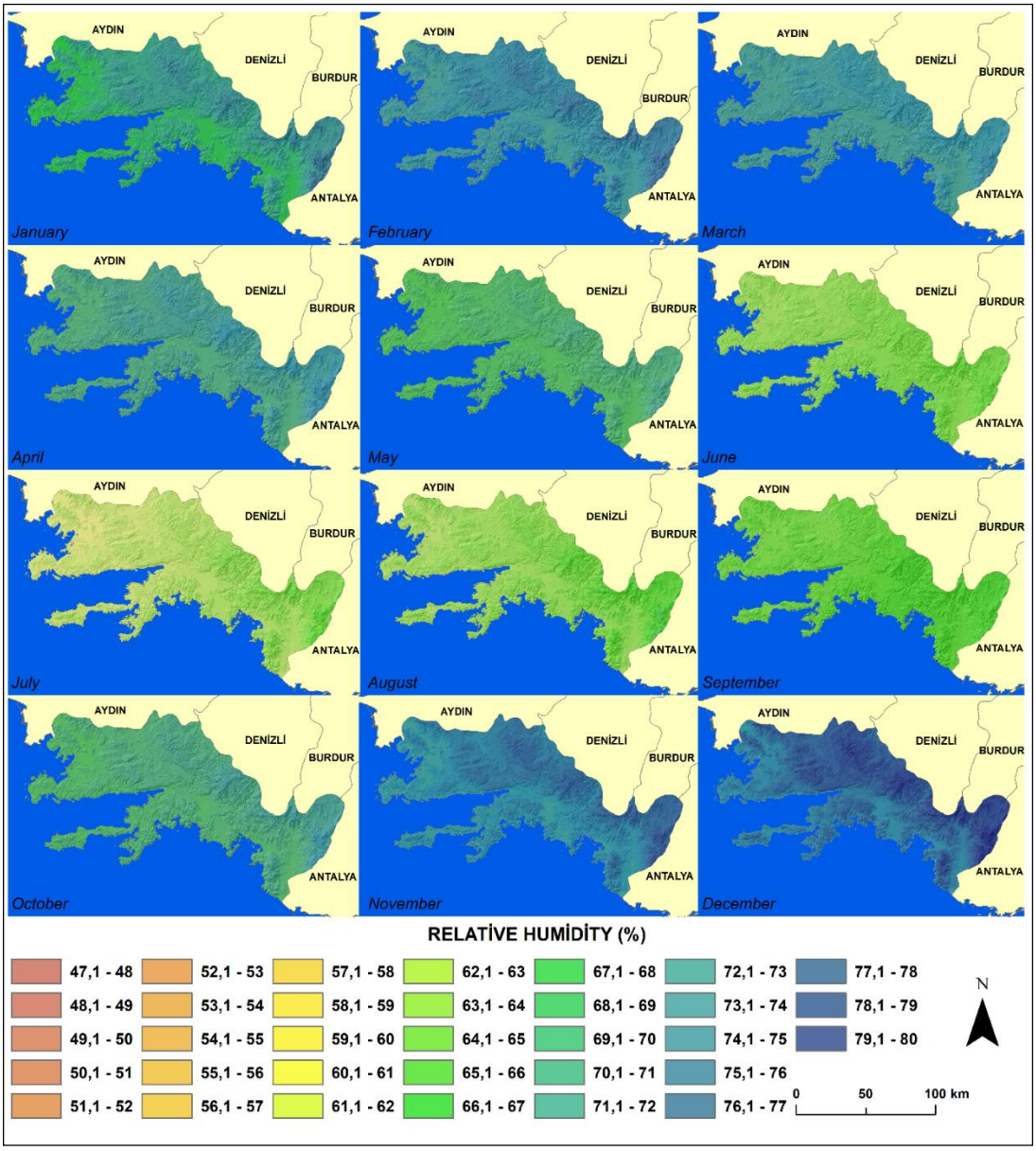

Figure 3: Monthly average relative humidity values of the study area

3.2 Temperature - Humidity Index (Discomfort Indices)

Temperature - Humidity Index was used to determine the climate comfort characteristics in the study area located in the Aegean Region coastal zone. When the index values are examined, the temperature values felt during the winter months (December, January, February) vary between 6°C and 14°C. While the temperatures felt in the high areas in the north and northeast of the study area are low, the temperatures felt in the coastal areas increase. In March, it is 10°C in high areas and around 14°C in lowland areas. In April and May, the temperatures felt increase and reach 22°C.

The temperatures felt in the summer months (June, July, August) do not exceed 25°C. While the felt temperatures are 21°C in the high areas, it is 24°C in the coastal areas. The temperatures felt in July reach the maximum value. This situation continues in August as well. In September, it decreases below 24°C. While the temperatures felt in October are 20°C in the plains, it drops to 15°C in the higher parts (Akdağ, Babadağ and Oyuklu Mountains).

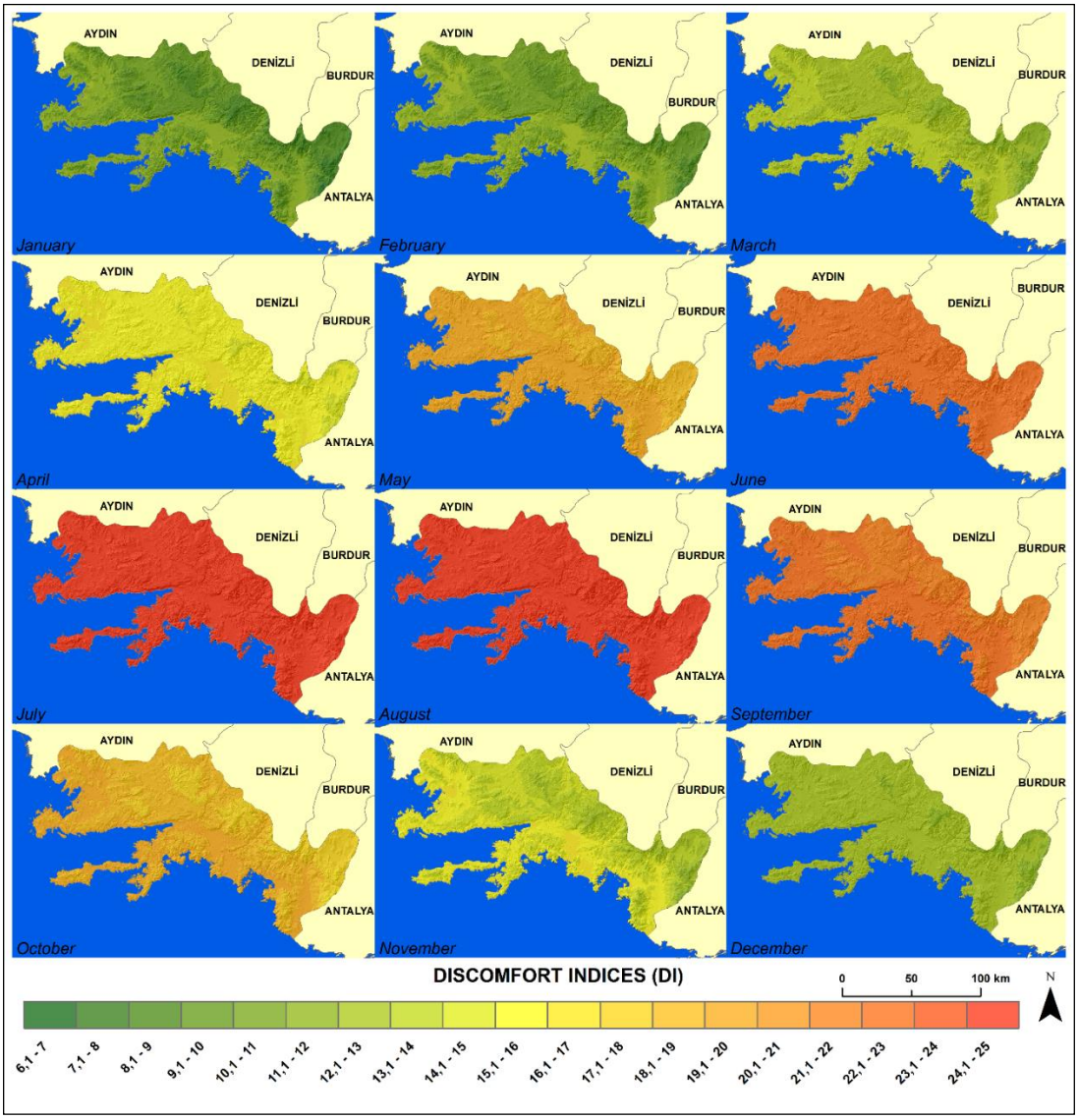

Figure 4: Study area of the temperature-humidity index (DI)

In November, it drops below 8°C in the east of the province. While the felt temperature values are minimum in the high parts of the research area, they reach the maximum values in the low parts of the coast (Figure 4).

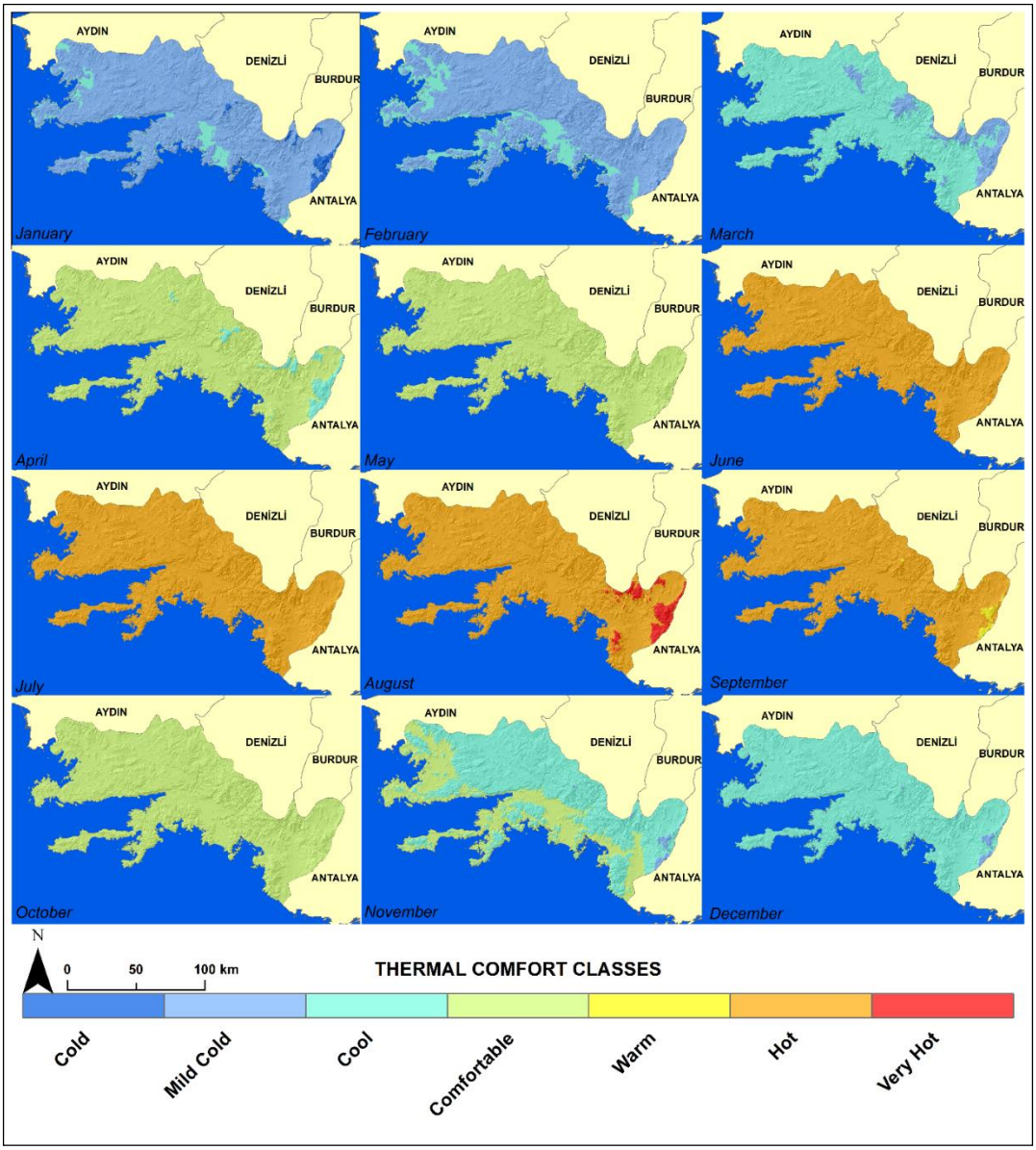

Figure 5: Study area of thermal comfort classes

When the discomfort index values of Muğla are examined; The temperatures felt in January range from cold to cool. While cold is felt in the high parts of Akdağlar, which is located in the east of Fethiye, a slight cold is felt in the west of Köyceğiz, Dalaman, and Milas. While the temperatures felt cool in the coastal areas in February, the temperatures felt from the west to the east changed and the cool comfort class left its place to the mild cold class. There was a big change in the temperature sensation in March. While the temperature feeling is cool throughout the province, it is felt slightly cool in the Akdağlar located in the west and the Oyuklu Mountains in the northeast of the city center. With April, the temperatures started to feel comfortable. In April, comfortable conditions prevail in almost the entire province, and the temperature felt in the high parts of the east is cool. On the other hand, it is felt comfortable in all of the low and high parts of Muğla in May. While the felt temperatures are comfortable in May, they change with June. The temperatures that felt comfortable in May left their place to the warm comfort class in June and July. While the temperatures felt in August are hot in the study area, it is felt very hot in a narrow area in the south and southwest. The temperature felt in September is similar to August. There is a feeling of warmth in all plains and foothills of the study area, but only in the higher parts

of the east. With October, it is felt comfortable in the whole of Muğla. In November, the low areas are comfortable and it is felt as cool at the foot of the mountains and slightly cold at higher altitudes. The temperatures felt vary between slightly cold and cool in December. While it is felt as cool in all plains and mountainous areas of Muğla, it is felt as slightly cold in the high parts of Akdağlar, located in the east of the province. In Muğla province, it is generally slightly cold and cool in December, January, and February, cool in March, comfortable in April and May, warm and cool in June, July, August, September, comfortable again in October, and cool in November and December. and slightly cold (Figure 5).

As a result of the analyzes made, the average Discomfort Index (DI) values were produced by using the temperature and relative humidity values. These values vary between 15.9°C and 18.2°C throughout the province. The minimum temperatures are seen in and around the high parts of the mountains, while the maximum temperatures are seen in the low parts of the coast.

Temperature Equivalent Psychology (SEP) classification was applied to the mean discomfort index values in Muğla province. As a result, it has been determined that the whole of the province is comfortable climatically.

4. Discussions and Conclusions

To determine the bioclimatic comfort characteristics of Muğla province, monthly average temperature and relative humidity data obtained from 9 meteorology stations were arranged and transferred to the GIS environment. Temperature and relative humidity data were evaluated by months using Co-Kriging methods and maps were created. The monthly average temperature values of the study area were examined and it was determined that it was in the appropriate range in terms of bioclimatic comfort. Considering the humidity values, it has been determined that the other parts of the province have suitable values in terms of bioclimatic comfort, except for the regions in the eastern and southeastern parts of the province with a relative humidity of over 70%.

In the study, the Temperature-Humidity Index (DI) produced by Thom using the climate parameters was calculated and the temperature values felt were determined according to the months. It has been observed that the temperatures felt in the winter season are low in the north, northeast of the province, and high in the coastal areas. The perceived temperatures do not exceed 25°C in summer. As a result of calculating the Discomfort Index values, the temperatures felt were classified by using the Psychology Equivalent to Temperature (SEP) scale.

The change in the bioclimatic comfort situation is in months and what kind of spatial distribution it exhibits are examined. When the variation of bioclimatic comfort according to the months is examined, it is felt as slightly cold and cool due to the low temperatures in December, January, February, and March. In April, May, and October, comfort conditions without any thermal stress cover a wide area throughout the province. Due to the high temperatures in June, July, August, and September, it feels hot. To make the temperatures felt in summer comfortable, it is necessary to increase the green areas in the city and to plan the streets in a way to ensure air circulation in the newly planned residential areas.

In Muğla Province, no discomfort was observed depending on the monthly average temperatures. Due to the lack of discomfort, it may cause tourists to prefer this area more. Before making investments for tourism purposes, it will help to determine the climate comfort characteristics and to reveal unused potentials in areas where comfort is appropriate.

Competing Interest / Conflict of Interest
The authors declare that they no conflict of interest. None of the authors have any competing interests in the manuscript.

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The Chancing of Mg Concentrations in Some Plants Grown in Pakistan Depends on Plant Species and the Growing Environment

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ABSTRACT

In this study, it has been tried to determine how Mg, which is one of the most important macronutrients for plants, changes in various organs of some plants grown intensively in urban centers in Pakistan, and how this change is affected depending on the washing status and traffic density. For this purpose, the variation of Mg concentrations in leaves and branches of *Ficus bengalensis*, *Ziziphus mauritiana*, *Conocarpus erectus*, and *Azadirechta indica* species depending on washing status and traffic density were determined. As a result of the study, it was determined that the Mg concentration changed statistically significantly ($p<0.05$) depending on the plant type and organ in all traffic densities, but there was no linear relationship between the change of Mg concentration and traffic density.

Anahtar Kelimeler:
Pakistan,
Magnezyum,
Mg,
Trafik.

ÖZ

Bu çalışma kapsamında bitkiler için son derece önemli makro besin elementlerinden olan Mg'un Pakistan'da kent merkezlerinde yoğun olarak yetiştirilen bazı bitkilerin çeşitli organlarında nasıl değiştiği, yıkama durumu ve trafik yoğunluğuna bağlı olarak bu değişimin nasıl etkilendiği belirlenmeye çalışılmıştır. Bu amaçla *Ficus bengalensis*, *Ziziphus mauritiana*, *Conocarpus erectus* ve *Azadirechta indica* türlerinin yaprak ve dallarındaki Mg konsantrasyonlarının yıkama durumu ve trafik yoğunluğuna bağlı değişimi belirlenmiştir. Çalışma sonucunda Mg konsantrasyonunun bütün trafik yoğunluklarında bitki türü ve organına bağlı olarak istatistiki olarak anlamlı düzeyde ($p<0,05$) değiştiği belirlenmiş, Mg konsantrasyonunun değişimi ile trafik yoğunluğu arasında ise doğrusal bir ilişki bulunmamıştır.

1. Introduction

The world population has increased significantly in the last century and is concentrated in urban areas [1, 2]. The most important problems of our age worldwide are the increase in population [3, 4] and the concentration of the population in urban areas, that is, urbanization [5, 6] listed as other problems. The demands and needs of the increasing population also diversify and increase in line with the requirements of the age, and the industrial production to meet these needs also increases the need for raw materials and energy [7, 8].

The wastes generated as a result of industrial production in this process cause excessive pollution of air [9,10], water [11,12], and soil [13-17]. Global climate change [13-17] and urbanization [18-20] are shown as the biggest irreversible problems of our age [21], and environmental pollution is seen as the most important problem threatening living life and ecosystem [22-24]. Especially in regions with high population density, air pollution is one of the most important problems threatening human life [25-27]. It is reported that 92% of the world's population lives in areas with low air quality and approximately 1 in 8 deaths are caused by air pollution [6, 27].

Plants grown in areas with high air pollution are also affected by this pollution. Because plant development, structure, and phenotypic characters are shaped depending on genetic structure [28-30] as well as environmental conditions [31-33]. While air pollution changes the composition of the air, it also changes the microecological conditions, and since plant growth is shaped by climatic [34] and edaphic [35,36] factors, plant growth, and content are directly affected.

In this study, it has been tried to determine how Mg, which is one of the most important macronutrients for plants, changes in various organs of some plants grown intensively in urban centers in Pakistan, and how this change is affected depending on the washing status and traffic density.

2. Material and Method

Within the scope of the study, it was aimed to determine the change of Mg concentration in *Ficus bengalensis* (Fb), *Ziziphus mauritiana* (Zm), *Conocarpus erectus* (Ce), and *Azadirechta indica* (Ai) plants, which are grown intensively in urban centers in Pakistan, depending on the organ, washing status, and traffic density. The study was conducted on materials collected from high-traffic (TRCOK), moderately heavy-traffic (TRAZ), and almost non-traffic (TRYOK) areas. The washing process was also performed on the branch and leaf samples taken from the individuals subject to the study, and the washed organs (Yk) and the unwashed organs (Ykm) were evaluated within the scope of the study.

Branch samples taken from individuals suitable for the study purpose were brought to the laboratory, separated into leaf and branch parts, and then washing was applied in half of these samples. The samples were kept in laboratory conditions for 15 days until they became room dry and then dried in an oven at 45 °C for two weeks. The dried plant samples were ground into powder and weighed 0.5 g and placed in tubes designed for microwave. 10 mL of 65% HNO3 was added to the samples. The prepared samples were then burned in a microwave device at 280 PSI and 180 ºC for 20 minutes. After the processes were completed, the tubes were removed from the microwave and allowed to cool. Deionized water was added to the cooled samples to make up to 50 ml. After the prepared samples were filtered through filter paper, they were read at appropriate wavelengths in the ICP-OES device. Mg concentrations were calculated by multiplying the obtained values with the dilution factor. This method used in the study is a method used in many studies to determine elemental analyzes in plants [8-10,37].

The obtained data were evaluated with the help of the SPSS package program, variance analysis was applied to the data, and homogeneous groups were obtained by applying the Duncan test to the groups that were statistically different at least 95% confidence level. The data obtained were simplified and interpreted by tabulating.

3. Results

The results of the analysis of variance regarding the variation of Mg concentrations depending on the plant species and traffic density are given in Table 1.

Table 1. Variation of Mg (ppm) concentrations by species and traffic density

	TRYOK	**TRAZ**	**TRCOK**	**F**
Fb	3628,4 Bb	1424,5 Aa	2582,5 ABb	5,4**
Zm	698,1 Aa	1325,1 Ba	1203,5 Ba	7,4**
Ce	3576,9 b	3640,4 c	3246,3 b	0,1 ns
Ai	1507,9 Aa	2628,0 Bb	2189,7 Bab	7,3**
F	9,4***	13,0***	5,2**	

***: p<0,001

When the variation of Mg concentrations based on species and traffic density is examined, it is seen that the changes based on species in all traffic densities are statistically significant ($p<0.01$) at a confidence level of at least 99%. As a result of the Duncan test, it was determined that the values obtained in Zm were in the first groups and the values obtained in Ce were in the last groups at all traffic densities.

It was determined that the change of Mg concentrations depending on the traffic density based on species was not statistically significant ($p<0.05$) in the Ce species. In other species, it is seen that the Mg concentration does not change concerning the traffic density. The results of the analysis of variance regarding the variation of Mg concentrations depending on the species, organs, washing conditions, and traffic density are given in Table 2.

Table 2. Variation of Mg (ppn) concentrations

		Status of wash	TRYOK	TRAZ	TRCOK	F
Fb	Leaf	Yk	374,6 Ac	1453,0 Bg	3560,0 Cl	20130,4***
		Ykm	7247,6 Cp	1884,4 Ah	3924,2 Bm	79126,9***
	Branch	Yk	3425,3 Bl	1211,8 Ab	1183,5 Ad	18777,2***
		Ykm	3465,9 Cm	1148,9 Aa	1662,2 Bg	57372,7***
Zm	Leaf	Yk	1121,6 Af	1294,2 Bd	1868,7 Ci	37638,0***
		Ykm	1066,4 Ae	1233,1 Bc	1680,5 Cg	15182,1***
	Branch	Yk	327,8 Ab	1394,8 Cf	657,5 Bb	63924,2***
		Ykm	276,7 Aa	1378,2 Cf	607,5 Ba	52937,8***
Ce	Leaf	Yk	5558,4 Bo	5963,5 Co	5445,2 Ao	180,5***
		Ykm	5473,8 Cn	5171,8 Bn	4717,5 An	1387,3***
	Branch	Yk	1617,4 Bh	2098,0 Ci	1233,2 Ae	12087,8***
		Ykm	1658,0 Ci	1328,4 Ae	1589,3 Bf	1914,7***
Ai	Leaf	Yk	2167,8 Ak	2712,6 Bl	3175,3 Ck	9012,3***
		Ykm	1873,7 Aj	2547,7 Bk	3062,9 Cj	22166,5***
	Branch	Yk	631,0 Ad	3045,1 Cm	1768,2 Bh	53252,2***
		Ykm	1359,0 Bg	2206,5 Cj	752,5 Ac	48612,7***
F			57746,0***	40926,8***	38497,3***	

***: p<0,001 Yk: washed Ykm. unwashed

When the table values are examined, it is seen that the change of Mg concentration based on organ in all traffic densities and based on traffic density in all organs is statistically significant at the 99.9% confidence level ($p<0.001$). In TRYOK areas, the lowest values were obtained in Fb leaves washed with Zm branches, the highest values were obtained in unwashed Fb leaves and Ce leaves. In TRAZ areas, the lowest values were obtained in washed Fb branches and unwashed Zm leaves, and the highest values were obtained in Ai branches washed with Ce leaves. The lowest values in TRCOK areas were obtained in Ai branches that were not washed with Zm branches, and the highest values were obtained in Fb leaves that were not washed with Ce leaves. Apart from this, it can be said that there is no general relationship between the change of Mg concentration in organs and traffic density.

4. Discussions

As a result of the study, it was determined that the changes in Mg concentrations in all traffic densities based on species were statistically significant (at least $p<0.01$). Mg, which is the subject of the study, is a macro element used by plants and is considered as the iron of the plant world and enters the chlorophyll structure. Mg is the central atom of

chlorophyll and is vital in photosynthesis. The excess of Mg prevents K uptake and negatively affects the root development of trees [38]. Numerous studies on Mg and other elements reveal that the level of element accumulation in different species is at different levels [37]. Studies show that the most important factor affecting element accumulation in plants is plant type [39].

The results of the study show that there is no linear relationship between traffic density and Mg concentration. The entry of elements into the plant body and their accumulation in organs can be mainly through roots and leaves. However, it is not easy to determine the source of the elements determined in the plant because these uptake pathways can work simultaneously [40]. Therefore, factors affecting soil and air composition also affect element concentrations in plants [41]. In urban areas, especially traffic-related air pollution increases the concentration of elements, many of which serve as micronutrients for plants [42,43]. Air pollution and anthropogenic factors in urban areas can also cause soil pollution [44-47]. Therefore, the concentrations of these elements in plants grown in these areas are at higher levels [48].

As a result of the study, it was determined that the Mg concentrations in different organs of the plants subject to the study were at different levels at all traffic densities. This situation is largely shaped by the anatomical structure of the plant and the mutual interaction of the plant and the elements. Like all phenotypic characters, plant metabolism also depends on plant genetic structure [49-53] and environmental conditions [54-56]. Therefore, stress level, which significantly affects plant metabolism [57-60], hormone applications [61-63], cultural processes such as pruning and shading [64,65] and many factors affect the accumulation of elements in plants [66].

In addition, the changing environment and soil structure due to human influence in urban areas and micro-ecological factors [67-69] also affect the change of element concentration in plant organs. Therefore, the elements in the soil or air also significantly shape plant development. High levels of elemental concentrations in the air or soil are a source of stress for the plant [70] and other stress factors affect plant structure and development [71,72,73]. Therefore, high concentrations of some elements in the air cause stress in plants, affecting plant growth, and the accumulation of these elements in plant organs are at a higher level [39,40].

The fact that the element concentrations in different organs of plants grown in the same environment are at different levels is directly related to the structure of the plant organ. Factors such as morphology, surface area, surface texture, and size of plant organs affect the entry and accumulation of elements in the plant organ [3]. Plant leaves take in the air through stomata, while they can also take in the elements in the air. Similarly, the hairy structure of the leaf or the rough and cracked surface of the bark can facilitate the adhesion of the elements, and especially the particles contaminated with various elements that can be a pollutant in the air, on the surface of the organs [7,73,74].

5. Conclusions and Recomendations

As a result, the change of element concentration in plant organs is the result of a complex mechanism depending on the interaction of many factors, and this mechanism has not been fully resolved yet. Studies on this subject have mostly focused on annual plants, and the number of studies on trees is relatively limited. For this reason, it is recommended that the studies on the subject be continued by diversifying and increasing and that the studies be carried out in controlled environments as much as possible.

Competing Interest / Conflict of Interest

"The authors declare that they have no competing interests"

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