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INTERNATIONAL STUDIES AND EVALUATIONS IN THE FIELD OF

LANDSCAPE ARCHITECTURE

EDITOR

PROF. DR. SERTAÇ GÜNGÖR

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Editörler

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Chapter 1

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To allow new leaves to emerge,
Sorrow cleans away the old leaves.
Don't be sad,
autumn is harsh,
But its end is bright
Mevlana

Rural landscape areas are important living spaces where people connect with nature and participate in recreational activities, as well as meet their food and raw material needs. Given the impact of global climate change, it is essential to prioritize human comfort when planning these areas, while permitting minimal interventions in nature. In the process of rural landscape planning, maintaining ecological balance and making planning decisions that enhance human well-being is crucial. As the recreational needs in rural areas increase, the attention of planners has been drawn to these spaces, leading to a diversification of tourism types. The appeal of rural lifestyles, free from stress and pressure, fosters a sense of freedom. This enhances individuals' longing for nature and their desire to return to it, positively influencing nature tourism. In this context, the sustainable development of rural landscapes is of great importance for both the protection of nature and the enhancement of people's quality of life (Hüsam et. al., 2021; Öztürk et. al., 2023).

People's love and longing for nature is a phenomenon that has persisted for years. This feeling has been profoundly felt across the world and in our country, especially during the COVID-19 pandemic, which led to countless deaths and numerous crises. "The unusual emotional states that emerged during the pandemic (Bogenç and Bekci, 2021) deeply affected individuals psychologically, as they spent days in quarantine, grappling with stress, anxiety, and depression. The disruption of daily routines has led to significant losses in people's social and economic lives, such as income and job loss, resulting in increased levels of depression and stress (Çelik and Diker, 2021). The psychological responses during the pandemic triggered emotions ranging from fear to indifference and fatalism. For instance, research on the SARS outbreak has shown us that psychological effects are not always short-lived and can lead to severe and persistent mental health issues (Taylor, 2019).

The environment created by the pandemic is a crisis situation that imposes feelings of anxiety as well as fear on individuals and society. The severity and reality of the outbreak, combined with how it is perceived, have exacerbated the negative impacts through uncontrolled responses, increasing the potential harm caused by the pandemic (Yıldırım, 2020). In this context, people's psychological preferences have become more pronounced, leading to frequent experiences of fear, anxiety, trauma, and panic.

However, while some individuals have adapted to this threat, others have begun to feel heightened anxiety. This has highlighted the need to focus on the individual and societal implications of the outbreak in psychological and sociological terms, leading to an increased interest in natural spaces. While the pandemic has had negative effects in many areas, the adverse impact of COVID-19 on Turkish tourism began in March 2020 and continued until the pandemic stabilized. Although the effects are not as severe as they were at the beginning, the tourism sector's challenges have significantly decreased. COVID-19 and similar outbreaks have caused various changes in individuals' holiday decisions, travel destination choices, and behaviors in the short, medium, and long term (Alaeddinoğlu and Rol, 2020; Öztürk et al., 2021).

Initial measures related to tourism included restrictions and cancellations of airline flights. Due to the virus originating in Wuhan and spreading globally, flights from Wuhan to Istanbul were canceled on January 22, 2020, by a Chinese airline. Subsequently, all flights originating from China were suspended starting February 5, 2020, as the rate of virus transmission increased (Demir et al., 2020). These restrictions led to a serious crisis in the tourism sector and intensified people's longing for both coastal and green areas.

Throughout history, human communities have transformed their biophysical environment both accidentally (through environmental impact) and intentionally (through environmental management) (Madanipour, 1996). "The complexity created by neglecting the concept of seasonality, which intertwines nature and society, has resulted in urban planning has led to this factor being increasingly overlooked in urban planning (Jauhiainen and Mönkkönen, 2005). When examining zoning plans, seasonal transitions pose temporal challenges in the functional use of land (Aghayeva and Bogenç, 2022). In these plans, seasonality is often not seriously considered, highlighting it as a neglected element. In modern urban planning, the focus on spaces is designed to be functional for living, working, and leisure, which brings different elements to the forefront in rural landscape planning (Kalay and Bogenç, 2022). This study regards the principle of seasonality in autumn as a universal aspect, moving away from the notion of "everyday life," and focuses on the impact of autumn coloration on tourism preferences within rural landscape planning.

Tourism in Rural Landscape Areas

Tourism is a fragile desire that can be easily abandoned. In situations where trust is lacking, such as in cases of fear and panic, tourism demand is often the first to be negatively affected (Yenişehirlioğlu et al., 2016). Additionally, tourism demand is elastic (Gökdeniz and Nuran, 2008), trust-based (Law et al., 2014), and falls within the realm of luxury consumption (Thurlow and Jaworski, 2012). While economic and social preferences play significant roles in consumers' travel decisions, in the post-COVID-19 era, these decisions have

shifted towards emotional and psychological desires. Negative events occurring in a tourism destination, whether on a macro or micro scale, typically result in fewer visitors. such as health crises or security threats like disease or terrorism (Lee and Chen, 2011).

Consumer behavior and travel demand can also be influenced by factors like individual economic well-being, disposable income, changes in costs, perceived health risks, and shifting consumption capacities (Lee and Chen, 2011:1421-1422; Dönmez and Türkmen, 2015; Dönmez and Türkmen, 2018). With the decline of the pandemic, the sector has begun to normalize in recent year. There has been a noticeable trend of people migrating to rural areas as they start to better appreciate the value of nature. While natural (green) areas are significant for individuals, it is crucial to integrate these spaces with recreational and social activities. Even passive relationships based on visual interaction with nature offers significant psychological benefits (Ulrich and Addoms, 1981; Öztürk et al., 2020; Dönmez and Türkmen, 2019). Being immersed in nature can help reduce stress from urban life, supporting the idea of urbanization (Ulrich and Parsons, 1992).

Similar to urban spaces, rural areas offer two forms of passive engagement that enhance human well-being. The first involves seeing and recognizing natural areas, while the second pertains to the awareness of these spaces' existence and accessibility without direct interaction (Kaplan, 1980; Ulrich and Addoms, 1981; Kaplan, 1992). Moreover, the diversity of nature-based tourism guides individuals toward more culturally and ecologically sensitive travel. For nature-based tourism to contribute to long-term sustainable economic development, it is essential to effectively promote the protection and management of natural areas (Köroğlu and Karaman, 2014). In doing so, nature-based tourism can protect natural habitats while also providing opportunities for the economic development of local communities (Kelkit et al., 2005).

Autumn Coloration in Rural Landscape Areas

The visual aesthetic changes in forested landscapes during autumn evoke a range of emotional responses. The color transformations experienced in the fall are among the most significant visual elements attracting the attention of the public and visitors in rural landscapes."The visual aesthetic quality of a natural slope forest's color changes can only be achieved through the selection of aesthetically superior tree species.

This study focuses on the visual aesthetic quality of local tree species in rural landscapes, as well as the processes involved in ecological sustainability and natural biodiversity. The shaded gaps found within forested areas play crucial roles in maintaining species diversity, forest stability, and ecosystem services. Analyzing both the compositions of tree species and the color changes experienced in autumn in visually aesthetically rich forest areas positively influences

individuals' desire to visit these spaces (see Figure 1). In conclusion, the high saturation values of green, red, and yellow colors in forested areas with visual aesthetic quality contribute to the formation of distinct color contrasts in rural landscapes, creating a pastoral scenery in nature.

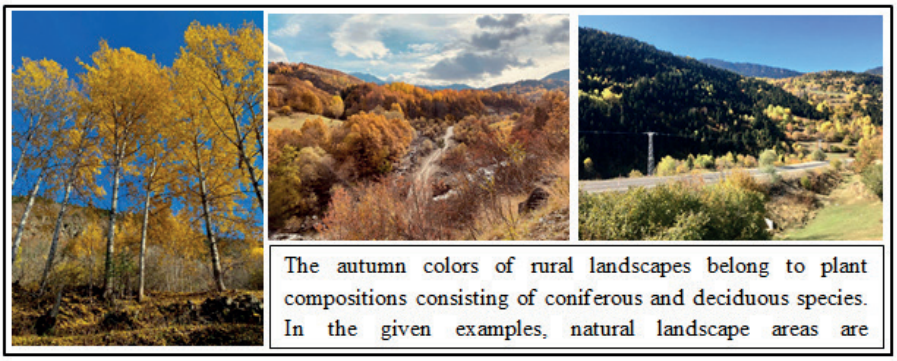

Figure 1. *Autumn visuals of rural landscape areas (Photos: Güler, 2023)*

Diverse and balanced color patches or scattered color components create contrasts with numerous small elements, further emphasizing the visual aesthetic quality of rural landscape areas. In essence, using color characteristics to create different combinations enhances the visual aesthetics of rural spaces and increases their overall quality.

The impact of autumn colorations observed in rural landscapes on tourism routes and natural trail corridors positively affects the tourism potential of these areas. Utilizing autumn colorations as a primary element in tourism activities not only supports rural development but also contributes to the preservation of ecosystem reserves (Güler, 2024). It is essential to remember that the leading component of the natural environment in tourism or recreational contexts is the quality of visuals or landscapes. The importance of landscapes lies not only in the benefits they provide to individuals but also in their relationship with the region's economic advantages. The visual quality of a space significantly influences the quality of both tourist and recreational experiences (Demir et al., 2019).

Plants are a crucial source of oxygen and act as the lungs of cities. They also contribute to a wide range of ecosystem services, including preventing soil erosion, providing micro-climatic environments, and supplying food and fuel (Sarı and Karaşah, 2018). Features such as form, texture, scent, seasonal coloration, and temporal changes in plants appeal to our senses, enhancing our satisfaction with outdoor spaces and allowing functional areas to transform into dynamic and livable environments (Karaşah, 2021). The primary goal of landscape ar-

chitecture is to meet human physiological, psychological, and aesthetic needs. As the key materials in design, plants play a significant role in creating aesthetic and functional spaces. They grow and develop over time, introducing a dynamic element to the spaces and enhancing the primary character of the landscape. Additionally, plants impart different meanings and functionalities to spaces based on aesthetic or functional use (Eren et al., 2018).

Color criteria in designs are an essential component of visual perception and spatial assessments. A large part of human visual perception is influenced by color criteria. Therefore, the color of vegetation is a crucial factor for evaluating and measuring landscape beauty. Color can stimulate the senses, increase attention, and help individuals be more aware of time. Seasonal color changes remind us that transient aspects are also a part of life. Spaces with flowering plants and color diversity are observed to be aesthetically preferable compared to others (Karaşah, 2021).

Seasonality and Rural Sprawl

The preservation of the uniqueness of forest colors in rural landscape areas is crucial for highlighting regional characteristics and supporting the sustainable development of forest vistas. However, the factors and mechanisms influencing forest color remain uncertain (Han et al., 2013). The concept of forest color is an essential element for maintaining landscape uniqueness, preserving regional characteristics, and ensuring the sustainable development of forest color landscapes. This, in turn, enables the provision of better, long-term, and stable landscape services to people (França et al., 2022).

Phenology, defined as the study of repeating biological events, has been a focal point of plant science for centuries (Lieth, 1973). The value of plant phenology, as a sensitive indicator of the impacts of "Global Environmental Change," has increased interest in the creation and interpretation of phenological records obtained through digital photography (Richardson et al., 2007). Each year, as summer ends in temperate regions, the autumnal leaf color change transforms the entire landscape into vibrant mosaics of yellow, orange, and red. Although much is known about the biochemistry and physiology of this color change, its adaptive significance is still unclear (Archetti et al., 2009). Seasonal dynamics are a typical characteristic of vegetation. The color changes, influenced by the progression of life stages and phenophases, are one of the most striking features (Xing et al., 2019). Mosaic patches in forested areas (gaps created by canopy dynamics) play significant roles in maintaining species diversity, stabilizing forest landscape structures, and facilitating ecosystem services (Chavez and Macdonald, 2010).

Nature serves as an excellent starting point for creating and defining color harmony in landscapes. Deciduous trees possess higher aesthetic quality than evergreen trees due to their autumn coloration. However, the color changes in

deciduous species in temperate climates continuously and diversely shift from green to various tones. In landscape architecture, color perception is vital for creating character and identity in spatial perceptions. The colors of objects not only influence emotions but also have profound effects on individual psychology. It is important to remember that the fundamental and instinctive visual appeal of color constitutes one of the most rewarding elements of landscapes.

Protecting the natural structures of rural areas under current conditions presents challenging and contradictory processes. The combination of population density and wealth in urban areas often renders rural spaces (particularly open green areas) scarce resources, with ongoing construction projects increasingly viewed as "urban sprawl" (Clawson, 1962; Türkmen and Dönmez, 2015; Meydan and Öztürk, 2023). The spread of housing and traffic is no longer limited to urban areas, which authorities refer to as "rural sprawl" (Mann, 2009). Lacking a better-defined term, rural sprawl is described as construction activities that degrade the natural or environmental quality of rural areas (Long et al., 2007).

A bridge must be established between the normative conditions created by rural sprawl and the rural landscape. Researchers examining agricultural land loss and urban sprawl often propose strategies for managing urban expansion (Mei et al., 2005). Some of these strategies can shape rural sprawl in certain contexts. However, effectively managing this process in popular areas often proves challenging. The rapid increase in human dominance over ecosystems is a primary cause of threats to biodiversity and species extinction (Vitousek et al., 1997). Urbanization, which contributes to rural sprawl, is a key factor increasing human dominance and posing significant threats to biodiversity (Liu et al., 2003). In areas experiencing rural sprawl, living spaces are directly eliminated, and even remaining habitats become fragmented (Swenson and Franklin, 2000), negatively impacting biodiversity.

The influx of housing developments into rural areas introduces another issue over time: the spread of exotic species in natural environments, which is classified as a tertiary environmental issue (Boyle and Samson, 1985). This significant problem is compounded by issues such as road density, land-use intensity, and recreation, which further increase human dominance over ecosystems. Many studies indicate that the adverse conditions experienced in rural sprawl stem from inadequately identifying ecological needs in land-use planning and growth management policies. Ecological measures aimed at agricultural lands are not effectively applied to forest areas. Rural forest communities are newer than farming communities, making community collaboration more challenging due to the isolation of individual households. As policymakers pursue urban continuity, they observe the extent of the problem posed by urban sprawl. Looking ahead, rural areas are anticipated to transform into urban spaces (Kew and Lee, 2013).

The carrying capacity of rural sprawl is critical in terms of the risks faced by natural areas within rural landscapes. Analyzing the spread's scale in relation to the landscape's impact reveals potential risk factors associated with future growth.

Conclusion

In rural landscape planning, the concept of tourism is often influenced by various normative factors. However, rural sprawl from metropolitan areas is viewed as a primary driver of degradation in rural spaces. Thus, making sound normative assessments is increasingly challenging. Recently, the shift or expansion of forests in many districts, accelerated construction, and the degradation of forest resources present an ironic situation. While previous studies focused on urban ecosystems, there is a notable shift toward researching ecological "natural" areas today (Bogenç and Bekci, 2020). Unfortunately, the topic of seasonality has garnered limited attention in academic literature. Nonetheless, new perspectives are emerging on how different regions perceive seasons, indicating a potential for future interdisciplinary research in planning strategies.

Autumnal color changes in rural landscapes make these vistas particularly captivating, offering greater potential for renewal compared to leafless views. By preserving "landscape features" and "ecosystem services" in rural areas, it is essential to analyze the quality of forest colors along greenway corridors, emphasizing their usability and increasing the frequency of applied case studies. It is important to note that the growing ecological and cultural needs of people lead to discomfort with anthropogenic activities, especially regarding recreational experiences in national parks. Increased anthropogenic disturbances can undermine or even eliminate the originality of forest colors, a concern emphasized by Fuller et al. (1998).

To better protect landscapes characterized by unique forest colors and restore degraded habitats, it is crucial to identify the factors affecting these colors positively and negatively. This will allow for more effective planning strategies and management models focused on destination areas in rural tourism, enhancing opportunities for social interactions. Systematic studies have shown that perceptions of tourism's impact on living environments influence the quality of life in destination areas. For a region to develop as a tourism destination, the perceptions of people towards that area must be favorable.

Since tourism experiences are subjective, defining tourism destinations can be quite challenging. Researchers need to leverage the characteristics of destination points to assess these definitions. Therefore, many studies should capitalize on the factors positively influencing tourism. In fact, tourism trips to rural areas will support " interaction with local culture," triggering individuals' experiences and presenting new tourism opportunities. To facilitate long-term

experiences in rural areas, rich and appealing content must be provided to individuals. The greater the variety in experiences, the stronger the visitors' loyalty to the destination.

By incorporating diverse activities into experience design, sustainable destination development can be achieved. Creating and expanding different tourism markets—such as viewing autumn colors—will enhance the understanding of the dimensions, types, and roles of tourism experiences. The findings from this study will illuminate other factors that contribute to the quality of tourism destination points, offering insights for future research and development in the field.

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Chapter 2

EDIBLE PLANTS IN UNIVERSITY CAMPUSES[1]

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1. Introduction

In the Paleolithic era, the first humans provided the nutrients they needed to survive by consuming many plant species found in nature (Özdemir & Erdal, 2021). In this context, edible plants have been of great importance since the very beginning of human history. In order to find food and meet their nutritional needs, people hunted and used the fruits, leaves, roots and tubers of plants. The most important factor in the transition of the first people, who had to be constantly on the move by hunting and gathering to feed themselves, to settled life was the desire to produce their own food (Yurtseven, 2023). This desire led to the emergence of agricultural activities and the cultivation of edible plants.

The main sources of livelihood of the Mesopotamian and Hittite civilizations living in Asia and due to their location were agriculture and animal husbandry. In addition, fruit trees were also included as they were used in agricultural activities. The first agricultural products in Mesopotamia included grains and legumes such as wheat, barley, lentils, chickpeas, peas, sesame and onions. These products were the main food sources of the Mesopotamian people. Apart from these cereals, the date palm was the plant that grew the most in Mesopotamia and contributed the most to the economy. There were also pomegranate, fig, apple and vine trees (Yıldırım & Aytan, 2023). The hanging gardens of the legendary Babylon, thought to have been built in antiquity, are known to have mulberry and various fruit trees in addition to grapes on terraces filled with soil supported by large stone blocks (Rajani, et al., 2023). Fruit trees also provided the main source of livelihood for the Hittites. Heavy fines for damage to fruit trees were demanded through Hittite laws. The Assyrians also attached great importance to fruit trees. The depictions of fruits such as pomegranate and figs on the reliefs of the Assyrians are remarkable. Based on the reliefs, it can be said that pomegranate, fig and plum trees were cultivated in the region in addition to dates (Şahin & Koçyiğit, 2021).

With their uses as spices, raw materials and wood products, plants have been an important component of trade throughout history. In addition, plants transported between different parts of the world via trade routes such as the Silk and Spice trade routes created economic value. Many plants have become essential components of local food culture, defining the flavor and identity of traditional dishes. Therefore, these plants have been used not only for trade but also to add flavor and aroma to dishes (Gül & Çelik, 2016).

Societies living in ancient cities engaged in agricultural activities and cultivated various fruit trees in order to meet their nutritional needs, trade and support the local economy. Olive trees were used for the production of olive oil and olive fruit. Olive trees were also used as a shade element in the landscape. Vine cultivation was common in ancient Greek and Roman cities. Grapes were

used for wine production and the fruits were consumed. Wine production and wine culture were very important in ancient cities (Aşkın & Kurt, 2019).

Plants commonly used in medieval monastery gardens included medicinal plants, fruit trees, herbs, leafy greens and flowers. Plants were used to meet food needs, to make medicines and for symbolic expressions of spirituality (Pouya, 2021)

In Renaissance gardens, fruit trees were used for food, income and aesthetic value (Rajani, et al., 2023). These trees were placed in symmetry and order in line with the garden design of the period. The gardens offered beautiful views for garden owners and visitors. Orange and lemon trees were used for their fragrant flowers and leaves as well as their fruits. Peach, apricot and fig trees were also used in abundance as both fresh and dried fruits. In Baroque gardens, fruit trees were used for both visual enrichment and food production. Apple, pear, peach, cherry and grape trees were the most commonly used fruit trees.

The Modernism era is a movement that began in the early 20th century and often focused on functionality and minimalist design (Irmak & Bilge, 2019). Plant design during the Modernism period reflects a functional, minimalist and contemporary approach. During this period, fruit trees and other plants in the gardens of buildings were often considered part of the aesthetic design. Plants were selected, arranged and maintained according to the principles underpinning the modern style.

In the postmodernism period, significant changes are seen in both landscape and planting design. The planting designs of this period contain diversity, irony, innovation and cultural references. Among the different fruit species, there are rare and exotic fruit trees. This approach increases the diversity of the landscape and creates interesting landscapes. Fruit trees in particular have not only aesthetic but also functional uses.

After the postmodernism period, green urban designs have gained importance with ecological awareness. These designs include sustainable approaches such as increasing green spaces in urban areas, water management, renewable energy use, waste management and recycling. In urban areas, green roofs and vertical gardens, xeric landscapes, rain gardens, permaculture, hobby gardens and edible gardens are practices to achieve sustainable approaches (Wang, 2016). These applications include the use of natural species and vegetal designs that mimic nature and offer diversity.

1.1. Edible plants

Edible plants are plants used in landscape design that can be consumed by humans and used as food. Edible plants add diversity and functionality to landscape designs by providing ecological, economic and social benefits

(Fetouh, 2018; Güneroğlu & Pektaş, 2022). There is also a wide variety of edible plant species (Figure 1).

Figure 1. *Some pictures of edible plants*

Used in landscape designs, these plants help meet people's food needs. By incorporating edible plants into their designs, landscape architects encourage users to utilize natural products for nutrition. For this reason, the use of natural species in edible garden designs is very important. These plants do not require human intervention and thrive according to the ecological characteristics of their environment. As they grow naturally, they are easily adapted to the areas where they are used and save on maintenance costs. With these features, they draw attention as indispensable elements of sustainable landscape designs (Kaya Şahin et al., 2020). Edible plants that contribute to sustainable gardening practices can reduce environmental impact by increasing food production and promoting the use of local resources.

Edible plants enhance the natural beauty of green spaces with their aesthetic characteristics such as color, texture and form. Today, edible plants have become more preferred because they have aesthetic values as well as being used as food (Çelik, 2017). These plants are among the indispensable elements of landscape designs with their flower, stem and fruit beauty, autumn coloration and habitus (Larinde & Oladele, 2014; Olgun et al., 2018; Karaelmas & Cengiz, 2020). By attracting beneficial creatures such as bees, butterflies and other pollinating insects to gardens, it diversifies the ecosystem and creates habitat for them. Edible plants also play an important role in teaching and learning processes related to landscape design. It provides students with practical experience in how to grow, care for and utilize plants in food production. It contributes to children's recognition of plants, especially by strengthening the bond between nature and humans. These plants also increase the value of

the space as they provide users with access to fresh and organic food. Considering all these factors, the importance of edible plants in landscape design cannot be ignored (Deelstra & Giardet, 2000; Aslan, 2020).

1.2. Usage Areas of Edible Plants

Edible plants are used in many places such as residential gardens, educational institutions, hospital gardens and gardens of different public spaces (Olgun et al., 2018). Edible plants in public spaces such as parks, streets, public transportation stations, etc. allow people to easily obtain the nutrients they need (Karaca, 2019). This improves food security. It also provides more food choices for people in low-income areas or areas with low food diversity. Moreover, it enables people to come together for a common purpose and strengthen social bonds (Wang, 2016). Provides the community with educational experiences about nature and agriculture.

The use of edible plants in residential gardens is quite common (Acar & Sarı, 2010; Surat, 2020). Growing these plants allows people to produce their own fresh and healthy food. At the same time, edible plants reduce the use of chemicals and contributes to the protection of soil and water resources. These plants save money in the long term by reducing the amount of money you spend on the food you buy and reduce costs. Supports environmental sustainability by reducing resources such as transportation and packaging and lowering your carbon footprint. Colorful vegetables, blooming fruit trees and aromatic plants add aesthetic value to gardens. Processes such as the care and harvesting of edible plants provide opportunities to strengthen bonds between homeowners and their families.

The use of edible plants in hospital gardens encourages the interaction of patients and visitors with nature and provides a therapeutic environment (Güneroğlu et al., 2018). Gardening, such as planting, maintaining and harvesting plants, helps patients to improve their manual dexterity and motor function. In this way, it contributes to the reduction of stress levels of patients and their healing processes. The use of edible plants such as fresh vegetables, herbs and fruits in hospital kitchens enables the preparation of nutritious and tasty meals. Delicious food contributes nutritionally to the healing process of patients (Sakıcı & Var, 2014). It brings patients, staff and visitors together, strengthening community bonds.

Edible plants used in educational spaces increase students' interaction with nature. Students learn cultivation techniques such as planting, care, irrigation, harvesting, soil care and follow the growth process of plants (Shi, 2023). In this way, students who develop a sense of responsibility are directed to collaborative works. Plant cultivation raises students' awareness about healthy eating. It also encourages students to adopt healthy eating habits. This experience helps students understand how nature works and develops their in-

terest in the natural environment and sustainability issues. Edible plants grown in the training areas bring families, local farmers or neighborhood residents together, strengthening their relationship with the educational institution.

University campuses are an important part of the urban landscape that changes the silhouette and life of cities, as well as areas where students live for at least 4 years and gain professional knowledge (Yılmaz, 2015, Ercan Oğuztürk & Pulatkan, 2023). Like cities, university campuses have functional functions such as work, rest, housing and recreation, and allow users to interact socially (Yıldız & Şener, 2006; Güneroğlu, & Bekar, 2018; Ercan Oğuztürk & Pulatkan, 2022). In addition to academic activities, campuses are places where knowledge, discoveries and innovations emerge, where student life takes shape and society interacts with younger generations. In university campuses with dense plant material, plant design applications with edible plants make campuses more valuable (Pektaş, 2023). Most university campuses around the world have orchards with edible properties (Fichtner, 2011).

2. Some Universities in the World with Edible Landscapes

2.1. University of Nevada - USA

This university is located in Reno, Nevada. The campus includes teaching and research buildings for different disciplines, sports fields and green areas (Figure 2). With its location on campus, Manzanita Lake is a favorite spot for students to relax and get in touch with nature. Students can walk and picnic around the lake. Manzanita Bowl is a large grassy area in the heart of the campus, surrounded by trees (URL-1). Outdoor events, concerts and meetings are organized in this area surrounded by green lawns. Students can enjoy social events in this area. Gateway square covers a large open area on the University of Nevada campus. This area has trees and seating areas. Students can relax, read a book and meet friends here.

Figure 2. *University of Nevada Campus picture (URL-2)*

The University of Nevada conducts a study called Nevada Living Learning Community in order to promote sustainability and organic agriculture. In this context, organic agriculture and plant growing activities are carried out in the gardens on campus (Figure 3). In these gardens, students can experience natural life and learn the principles of organic farming. These principles include limiting the use of chemical fertilizers and pesticides, preferring natural fertilizers and organic methods, maintaining soil health and promoting biodiversity. Students learn the basic principles of organic farming and experience it in practice. They can also work on real projects in these gardens, monitor plant growth, conduct soil analysis and learn agricultural techniques, as well as research on sustainability and environmental awareness (Fichtner, 2011).

Figure 3. *University of Nevada edible garden application (URL-3)*

2.2. Cornell University - USA

Cornell University is located in the city of Ithaca in the state of New York, USA. The university campus includes faculty buildings, student housing, sports facilities, libraries, laboratories, and other academic and administrative buildings (Figure 4) (URL-4). One of its most famous green spaces is the area known as the "Arts Quad", located in the center of the university. This area features a large lawn surrounded by trees and beautiful landscaping. Students can sunbathe, study and spend time with friends. The Cornell Botanical Garden is also famous for its green spaces. This botanical garden is home to a diverse collection of plants and offers visitors a pleasant stroll through nature.

Figure 4. *Cornell University Campus picture (URL-5)*

The orchards at Cornell University support a variety of research projects to support the burgeoning fruit industry and provide consumers with healthy, delicious and high quality fruit (Figure 5). Many fruits such as apples, pears, grapes, peaches, plums and cherries are grown on these plots. In addition, these orchards serve as laboratories for hundreds of students each year, providing an experience space to show future generations of growers and researchers all aspects of fruit production. Teaching areas include fruit growing, wine making, orchard management (URL-6). The orchards are used both for academic purposes and to provide information and advice to farmers and the community on fruit growing. The aim is to contribute to the agricultural sector and promote innovation in fruit growing.

Figure 5. *Cornell University edible garden application (URL-7)*

2.3. Stanford University - USA

Stanford University is located 40 km southeast of San Francisco in California, USA (URL-8). It is a world-renowned educational institution and research center (Figure 6). The main square, considered the heart of the University, con-

tributes to the visual appeal of the campus, which is covered with lawns, various trees and flowers. The White Memorial Square is an open square where students often use to relax, chat and read books. The botanical garden, which stands out with its collection of desert plants, is an ideal place for those who want to discover various plant species. The radio telescope (The Dish), located south of Stanford, is an open green space used for recreational purposes such as walking, jogging and cycling. Lake Lagunita is an area where students can interact with nature, with limited swimming or paddling allowed during certain periods.

Figure 6. *Stanford University Campus picture (URL-9)*

Stanford University is a pioneer in environmental sustainability and natural resource conservation. For this reason, edible landscaping practices are also common on campus (Figure 7). Specific areas have been set aside on campus for growing and collecting edible plants and edible gardens with a variety of vegetables, fruits and natural herbs have been created. Students and staff can work in these gardens to produce organic products and consume fresh produce (Fichtner, 2011). In addition, events and workshops are organized in these gardens to share knowledge on sustainable agriculture and horticulture. There are also events and seminars organized to explore and be inspired by examples of edible landscaping practices on campus. In particular, water efficiency has been increased by using rainwater harvesting systems, reusing water and reducing the need for irrigation in order to manage water resources sustainably.

Figure 7. *Stanford University edible plant picture (URL-10)*

2.4. University of Roehampton-UK

The University of Roehampton is located in Roehampton, southwest London. The University campus is set in a large and beautiful landscape and offers students a natural environment (Figure 12). The green areas within the campus provide a wide environment where students can rest, socialize and study outdoors (URL-11). The campus has lawns, trees, flower gardens and seating areas. These areas are ideal for students to relax between classes, do group work and connect with nature. The natural areas around the university campus are also worth exploring. Richmond Park, located near the campus, is the largest royal park in the UK and is famous for its extensive meadows, forests and wildlife (URL-12). Popular with visitors for its natural beauty, historical and ecological value, this park is a great option for students to enjoy nature walks, jogging and picnics.

Figure 12. *Roehampton University Campus picture (URL-13)*

The Growhampton project at the University of Roehampton is an effort to promote sustainability, environmental awareness and community engage-

ment. This work provides an opportunity to gain practical experience while educating students and the local community on sustainability issues by running various projects on the university campus. The projects include a variety of sustainable agricultural practices such as organic gardens, plant growing areas, farms, apiaries and natural habitats (Figure 13). It also organizes environmentally friendly workshops, events and training programs. Aims to raise public awareness of sustainable lifestyles. Growhampton also offers support for students to develop sustainability-related projects and realize their own sustainable business ideas (URL-14).

Şekil 13. Roehampton Üniversitesi yenilebilir bitki görseli (URL-15)

2.5. Eskişehir Osmangazi University-Türkiye

Eskişehir Osmangazi University consists of five campuses in the center of Eskişehir: Meşelik (Figure 14), Bademlik, Çamlık, Eskişehir Organized Industrial Zone and Ali Numan Kıraç. In addition to tennis courts, football, basketball, volleyball, handball, volleyball and handball courts, sports activities such as boxing, table tennis, swimming, archery, mountaineering, badminton, arm wrestling, chess, bridge and are rugby also carried out on the campus (URL-16). There are also green areas where students can sit, rest and study. These areas provide students with the opportunity to meet with natural areas and contribute to social life.

Figure 14. *Eskişehir Osmangazi University Meşelik Campus picture (URL-17)*

Osmangazi University Faculty of Agriculture Education, Research and Application Farm in Eskişehir province was established on 112 acres in Ali Numan Kıraç Campus. In the orchards of the farm, cherry, apple, plum, peach, apricot, nectarine, pear, sour cherry, mulberry, almond, walnut are grown (Figure 15). The farm has nearly three thousand trees where academics and students conduct research, education and experiments. Visitors who come here away from city life can also have a pleasant time by participating in the processes of growing and collecting fruit in a natural environment (URL-18).

Figure 15. *Eskişehir Osmangazi University Ali Numan Kıraç Campus edible plant picture (URL-18)*

2.6. Yıldız Teknik University -Türkiye

Yıldız University is a well-established university with two different campuses in two different districts in Istanbul. The Yıldız campus, located in Beşiktaş district, is home to engineering faculties. The Davutpaşa campus in Zeytinburnu district houses various faculties, institutes and research centers (Figure 16). The Central Garden is located at a central point of the campus and is

a place where students can rest, socialize and participate in activities. While Davutpaşa Campus offers students the opportunity to study in a historical and natural place, it is considered one of the most beautiful campuses in the world with its green areas and social structures. The campus, which protects green areas, adopts resource efficiency and sustainability principles, and includes the elements of being a pedestrian-priority barrier-free campus, continues its existence in a structure that is friendly with the environment, people and the future (Ercan Oğuztürk, 2022).

Figure 16. *Davutpaşa campus picture (URL-19)*

Within the Davutpaşa campus of Yıldız Technical University in Istanbul, an area of 3500 square meters is used as a hobby garden. Each garden consists of 50 square meters (Figure 17). Students and staff manage their own garden plots and carry out plant growing and horticulture activities. Each garden is leased for five years and the use of pesticides is prohibited (URL-20).

Figure 17. *Yıldız Technical University Davutpaşa campus hobby garden picture (URL-21)*

3. Conclusion

Universities are considered an important social, cultural and economic resource for cities. In addition to focusing on academic achievement, university campuses are important places that offer many opportunities to improve the quality of life of students and staff. Green spaces in these campuses come to the forefront with various advantages. In the university campuses researched within the scope of the subject, it is seen that the use of plants with edible properties is emphasized. In particular, it has been determined that these plants provide many ecological, economic and social benefits to the campuses. With these plants, it is aimed to provide both nutrition and environmental awareness within the university campuses. In addition, opportunities have been created for students to connect with nature. In addition to these, the sustainability goals of universities are supported ecologically.

As a result, the use of edible plants, whether herbaceous or woody, in the forms of ground cover, shrubs and trees in urban green areas is very important for today's cities. For these reasons, it is necessary to increase the use of these plants in plant designs with their nutritional values besides their aesthetic features such as form, flower, leaf. Especially in educational areas, it should not be forgotten that these plants provide environmental awareness to students at an early age.

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Chapter 3

BENEFITING OF NATURAL PLANT TAXA IN XERISCAPE APPLICATIONS

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INTRODUCTION

Nowadays, green infrastructures are forced to change day by day due to anthropogenic influences and are replaced by impermeable surfaces and structural elements (urbanization). Newbold et al. (2016) emphasized that humans are changing the globe at an unprecedented rate, leading to record losses in biodiversity (Johnson et al., 2017). Peng et al. (2011) stated that the urban heat island (UHI) effect is one of the most prominent examples of anthropogenic impacts on the natural environment observed globally (Yang and Wang, 2017). However, urban green infrastructures provide valuable ecosystem services such as climate regulation, pollination, air quality regulation as well as aesthetic effects.

One of the environmental problems brought about by urbanization is water scarcity. Water scarcity is a critical issue affecting more than 40 percent of the global population (Karimian et al., 2017; Nirmala and Jyothi, 2022), and this scarcity is caused by world population growth, climate change due to global warming, pollution and unconscious consumption of water resources. Water is one of the most limited resources on earth (Boyle et al., 2016). Therefore, it is critical that about 25% of water resources are consumed for irrigation of urban landscapes (Welsh et al., 2007; Rafi and Kazemi, 2021). According to the international Falkenmark index, is used to define water scarcity or stress, countries or regions with an annual total amount of usable water per capita between 1,700 ~ 1,000 m^3 are said to be in "water shortage". For 2022, the annual amount of usable water per capita in our country is 1,313 m^3. Unfortunately, with the expected decrease in our water potential due to increasing population and the effects of climate change, the annual amount of usable water per capita is expected to fall below 1,000 m3 after 2030 (Ministry of Agriculture and Forestry, General Directorate of Water Management, 2024).

The fact that water consumption has reached great dimensions, especially in open green areas, has necessitated the development of new methods that use as little water as possible in landscape arrangements. In this direction, new landscape arrangement concepts such as "Natural Landscaping", "Low-Water" and "Water-Wise, Water-Smart" have been developed under the general title of "Water-Efficient Landscaping" (Wade et al., 2002; Barış, 2007; Bayramoğlu, 2016; Çorbacı and Ekren, 2022). Nowadays, xeriscape applications are popular as a water-efficient landscape approach in the discipline of landscape architecture (Karaşah, 2022).

In this context, it has become crucial to use drought-resistant and region-specific natural species when selecting plant material to create a sustainable and healthy vegetation in urban areas, especially in recent years (Tırnakçı and Aklıbaşında, 2023). Because the preference of natural plant taxa in planting design studies increases the success of landscape applications.

Xeriscape landscapes are defined as quality landscapes that save water and protect the environment. Xeriscape means low water use. It does not mean dry or barren looking (Al-Azhari, 2012). Xeriscaping is a holistic approach that uses planning, design and selection of appropriate native plant species, water-saving irrigation techniques and other practices to make the landscape more sustainable (Aklanoğlu, 2007; Çetin et. al., 2018). Xeriscaping is landscaping that reduces or eliminates the need for irrigation (Nirmala and Jyothi, 2022).

The US Environmental Protection Agency (Wescoat, 2013) describes the specific benefits of xeriscaping as follows: Reduced water use, reduced energy use (less pumping and treatment required), reduced heating and cooling costs due to carefully placed trees, reduced rainwater and irrigation runoff, less garden waste, increased habitat for plants and animals, and lower labor and maintenance costs (Çetin et al., 2018). In addition, Nirmala and Jyothi (2022) describe the benefits of xeriscaping as reducing fertilizer use, helping you save money, reducing pollution, increasing property value and aesthetically appealing.

Xeriscape's seven principles are 1. Water-wise Planning and Design, 2. Low-Water Using Plants, 3. Limit Grass Areas, 4. Water Harvesting Techniques, 5. Efficient Irrigation System and Design, 6. Mulch, 7. Proper Maintenance (Al-Azhari, 2012).

In this study, it was aimed to reveal the potential of plant taxa that naturally occur in Nevşehir to be utilized in xeriscape designs.

Material And Method

Drought (water scarcity) events experienced with increasing temperatures in recent years as a result of global climate change have made xeriscape applications very important, especially for Central Anatolian cities in the semi-arid climate zone. The main material of the study consists of plant taxa naturally distributed in Nevşehir.

Nevşehir is located between 38° 12' and 39° 20' north latitude and 34° 11' and 35° 06' east longitude in the Central Anatolia Region (Anonymous, 2017). In Nevşehir, where the continental climate prevails, winters are cold and rainy, and summers are very hot and dry. Precipitation drops in the fall and spring throughout the province. However, due to climatic changes in recent years, snowfall in winter has been replaced by short-term rainfall. The average annual precipitation of the province is 422.9 mm. The highest temperature in summer is 39.5 °C, while the lowest temperature in winter is -23.6 °C (Anonymous, 2018b). According to De Martonne's Drought Index, it falls between semi-arid and humid climates (Ulukuş and Tugay, 2014). In recent years, spring months are generally rainy. According to the drought map of the General Directorate

of Meteorology (MGM) (2024), it can be said that there is severe drought in the study area according to the data between April 2024 and May 2024 (Figure 1).

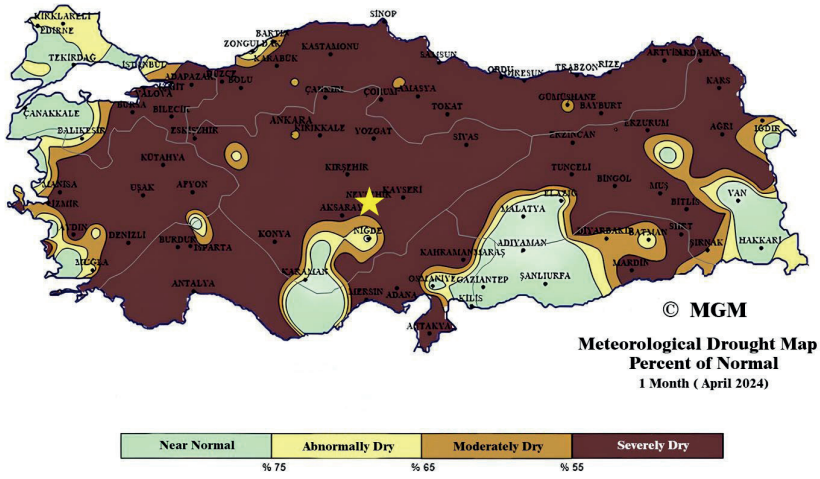

Figure 1. Drought map of Turkey (MGM, 2024) in April 2024

Steppe vegetation is the dominant vegetation in the study area, which is in the Iran-Turan phytogeographic region. Forests have been significantly degraded and there are dry forests consisting of Larch (*Pinus nigra*), Oak (*Quercus* spp.) and Juniper (*Juniperus* spp.) species around the anthropogenic steppe areas (Günal, 2013).

Nevsehir soils are composed of volcanic tuff. For this reason, the soils of Nevşehir, which have medium and light texture, are permeable. Regosels are the most common soil type in the study area. The amount of humus is low in these soils (Şıkoğlu, 2017). Kızılırmak is the most important major river in Nevşehir. There are also many large and small seasonal streams. Underground water resources are used as drinking water and irrigation water. As a result, most of the underground water resources dry up in the summer months (Anonymous, 2017). At this point, city municipal water is used for irrigation of urban open-green areas throughout the province.

The study was carried out in 3 stages. In the first stage, as a result of the literature review, 40 of the natural plant taxa growing in the region were selected by considering the aesthetics and water demand of the plants. In determining these plants, different studies in the literature on natural vegetation (Akkemik, 2018; Vural et al., 1996; Örnek et al., 2014; Ulukuş and Tugay, 2014) and plant database site (TUBIVES 2022) were utilized. In the second stage, a table was created that includes the dendrological characteristics of the natural taxa that

can be used in xeriscape applications in the region, their usage areas in landscape architecture and water demand. In the third and final stage, a suggested plant list was created that can be used in applications with xeriscape characteristics that include spaces such as socialization/recreation (seating areas, assembly areas, pergolas), watching (promenades, waterfront), entrance, car park, screening (wind, noise) within the framework of the need-activity-space relationship.

RESULTS

The plants considered in the study are Iran-Turanian elements and it was paid attention that the selected plant taxa have aesthetic and functional features and especially have low water demand. For this reason, phenological characteristics of the plants such as flower, fruit, seasonal coloration, reasons for preference in landscape design and water requirements were taken into consideration. In this context, plant taxa that can be used in xeriscape arrangements in urban areas for the study area, which falls between semi-arid and humid climates according to De Martonne's Drought Index, were selected by considering their water demand and their uses in landscape architecture and are given in Table 1.

Table 1. *Native plant taxa that can be used in arid and semi-arid climatic zones for xeriscaping*

No	Plant name	Family	Size	Reason for preference in design	Water demand
1	*Celtis tournefortii* Lam.	Ulmaceae	Tree	Form characteristic	Little
2	*Elaeagnus angustifolia* L.	Elaeagnaceae	Tree	Decorative structure and colour of fruits and leaves, aromatic characteristic	Little
3	*Fraxinus angustifolia* Vahl. subsp. *angustifolia*	Oleaceae	Tree	Form characteristic, autumn colour	Little
4	*Hippophae rhamnoides* subsp. Caucasica Rousi	Elaeagnaceae	Tree	Decorative structure and colour of the fruits	Little
5	*Pinus nigra* subsp. *pallasiana* (Lamb.) Holmboe	Pinaceae	Tree	Form characteristic	Little
6	*Populus tremula* L.	Salicaceae	Tree	Trunk aesthetics, autumn colours	Medium
7	*Pyrus eleagnifolia* Pallas subsp. *eleagnifolia*	Rosaceae	Tree	Aromatic and calligraphic characteristic	Little

8	*Quercus pubescens* Willd. subsp. *pubescens*	Fagaceae	Tree	Autumn colour, decorative structure of fruits	Little
9	*Ulmus minor* Miller subsp. *minor*	Ulmaceae	Tree	Form characteristic, autumn colours	Little
10	*Amygdalus orientalis* Lam.	Rosaceae	Small tree	Decorative structure of flowers	Little
11	*Crataegus monogyna* C. Koch	Rosaceae	Small tree	Decorative structure of fruits and flowers	Little
12	*Rhus coriaria* L.	Anacardiaceae	Small tree	Autumn colour, decorative structure of fruits	Little
13	*Sorbus umbellata* (Desf.) Fritsch. var. *umbel!ata*	Rosaceae	Small tree	Decorative structure of fruits	Little
14	*Tamarix parviflora* DC.	Tamaricaceae	Small tree	Decorative structure of flowers	High
15	*Berberis crataegina* DC.	Berberidaceae	Shrub	Decorative structure of fruits and flowers	Little
16	*Colutea cilicica* Boiss. Et Bal.	Leguminosae	Shrub	Decorative structure of fruits	High
17	*Cotoneaster nummularia* Fisch. et Mey.	Rosaceae	Shrub	Decorative structure of fruits	Little
18	*Genista sessilifolia* DC.	Fabaceae	Shrub	Decorative structure of flowers	Little
19	*Jasminum fruticans* L.	Oleaceae	Shrub	Decorative structure of fruits and flowers	High
20	*Juniperus oxcedrus* L. subsp. *oxycedrus*	Cupressaceae	Shrub	Form characteristic	Little
21	*Rosa canina* L.	Rosaceae	Shrub	Decorative structure of fruits and flowers, aromatic characteristic	Little
22	*Rosa hemisphaerica* J. Herrm.	Rosaceae	Shrub	Decorative structure of flowers, aromatic characteristic	Little
23	*Thuja orientalis L.*	Cupressaceae	Shrub	Form characteristic	Little
24	*Viburnum opulus* L.	Caprifoliaceae	Shrub	Decorative structure of flowers, aromatic characteristic	Little
25	*Clematis orientalis* L.	Ranunculaceae	Climber	Decorative structure of flowers	Little

26	*Lonicera etrusca* var. *etrusca*	Caprifoliaceae	Climber	Decorative structure of flowers, aromatic characteristic	High
27	*Vitis vinifera* L.	Vitaceae	Climber	Decorative structure of fruits	Little
28	*Achantolimon acerosum* (Willd.) Boiss. var. *acerosum*	Plumbaginaceae	Ground cover	Form characteristic, decorative structure of flowers	Little
29	*Astragalus lagurus*	Fabaceae	Ground cover	Form characteristic, decorative structure of flowers	Little
30	*Anthemis tinctoria* var. tinctoria (Willd.)	Asteraceae	Ground cover	Decorative structure of flowers	Little
31	*Centaurea depressa* Bieb.	Asteraceae	Ground cover	Decorative structure of flowers	High
32	*Colchicum triphyllum* G. Kuntze	Liliaceae	Ground cover	Decorative structure of flowers	Little
33	*Dianthus crinitus* Sm. var. *crinitus*	Caryophyllaceae	Ground cover	Decorative structure of flowers	Little
34	*Globularia trichosantha*	Globulariaceae	Ground cover	Decorative structure of flowers	Little
35	*Lotus aegaeus* (Gris.) Boiss	Fabaceae	Ground cover	Decorative structure of flowers	Little
36	*Mentha longifolia* (L.) Hudson Subsp. Typhoides (Brıq.) Harley Var. Typhoides (L.) Hudson	Lamiaceae	Ground cover	Aromatic characteristic	Little
37	*Scutellaria orientalis* subsp. *pinnatifida*	Lamiaceae	Ground cover	Decorative structure of flowers	Little
38	*Sedum subulatum* Boiss.	Crassulaceae	Ground cover	Decorative structure of flowers and leafs	Little
39	*Thymus sipyleus* Boiss.	Lamiaceae	Ground cover	Aromatic characteristic	Little
40	*Stipa pulcherrima* K.Koch	Poaceae	Herbaceous	Decorative structure of flowers	Little

As a result of the evaluation of the families to which the selected plants belonged, the most common families were 7 taxa (Rosaceae), followed by 3 taxa (Fabaceae), 3 taxa (Lamiaceae), 2 taxa (Elaeagnaceae), 2 taxa (Oleaceae), 2 taxa (Cupressaceae), 2 taxa (Caprifoliaceae), 2 taxa (Ulmaceae), 2 taxa

(Asteraceae), 1 taxon (Pinaceae), 1 taxon (Salicaceae), 1 taxon (Fagaceae), 1 taxon (Anacardiaceae), 1 taxon (Tamaricaceae), 1 taxon (Berberidaceae), 1 taxon (Leguminosae), 1 taxon (Vitaceae), 1 taxon (Plumbaginaceae), 1 taxon (Ranunculaceae), 1 taxon (Liliaceae), 1 taxon (Caryophyllaceae), 1 taxon (Globulariaceae), 1 taxon (Crassulaceae), 1 taxon (Poaceae) (Table 1).

When the selected plants were evaluated in terms of size; 9 of them were classified as trees, 5 as shrubs, 10 as shrubs, 3 as climber, 12 as ground cover and 1 as herbaceous. The reason for the selection of plants in different sizes is to ensure the principle of layering in the planting design to be made in the xeriscape application. (Table 1).

When the 40 plants selected within the scope of the study were evaluated according to their water demands, it was observed that 34 taxa had low, 1 taxon had medium and 5 taxa had high water demands (Table 1).

In a region-specific xeriscape design, the plant taxa as:

- With their effective form feature and autumn colours in emphasizing the entrances of spaces and providing direction, *Fraxinus angustifolia* Vahl. subsp. *angustifolia, Quercus pubescens* and *Ulmus minör,*

- *Populus tremula*, which attracts attention with its autumn colour and trunk aesthetics in providing mass-void balance in open spaces such as common use areas, assembly and dispersal areas,

- With their effective flowers, fruits and aromatic smell in supporting structural elements, *Rosa canina, Rosa hemisphaerica, Jasminum fruticans* and *Cotoneaster nummularia*,

- *Juniperus oxcedrus* subsp. *oxycedrus* and *Thuja orientalis*, which are effective coniferous taxa with their form characteristics, are used to define the entrances of the building, to determine the boundaries of the area and to form a background for the other plants,

- *Vitis vinifera*, which is identified with the region, with their flowers and smells *Lonicera etrusca var. Etrusca* and *Clematis orientalis* for creating shade and cool places in semi-open seating areas,

- With its effective flowers and fruits C*rataegus monogyna, Amygdalus orientalis, Rhus coriaria*, with its effective autumn colours *Rhus coriaria*, with the decorative structure of its fruits *Sorbus umbellata*, fo directing users on formal or informal axes that will provide circulation within the area,

- *Berberis crataegina* and *Viburnum opulus*, which are effective with their flowers and fruits in providing mass-void balance under trees,

- *Celtis tournefortii* and *Fraxinus angustifolia* branching from the top to provide shade in car parks,

- *Elaeagnus angustifolia* is effective in creating a wind or dust screen with its leaf color, fruits and aromatic characteristic,
- With its effective pink-colored flowers on the waterfront *Tamarix parviflora,*
- *Pyrus eleagnifolia* subsp. *eleagnifolia*, which is effective with its flowers and fruits that attract attention with their calligraphic structure for the focal point, can be used.

Additionally, ground covers such as *Achantolimon acerosum* var. a*cerosum, Stipa pulcherrima, Thymus sipyleus, Sedum subulatum, Scutellaria orientalis* subsp. *pinnatifida, Mentha longifolia, Lotus aegaeus, Globularia trichosantha, Dianthus crinitus* var. *Crinitus, Colchicum triphyllum, Centaurea depressa, Anthemis tinctoria* var. *tinctoria* and *Astragalus lagurus* can be preferred with their decorative feature of its flowers as a complementary element to xeriscape

One of the basic principles of xeriscape applications is to give less space to grass areas. Instead of grass, slag, which has a lot of resources in the region, can be used to keep the soil moist. Taxa such as *Berberis crataegina, Cotoneaster nummularia, Sedum subulatum, Thymus sipyleus, Tamarix parviflora* can be used in sloping areas.

CONCLUSION

Drought caused by changing climatic conditions makes it difficult to obtain plant materials that can be used in landscape arrangements and suitable for extreme environmental conditions. The rational use of water, which constitutes the most important element in ensuring the sustainability of planting design, is very important at this point. Including native plant taxa in xeriscape where water is used rationally is an important and effective way both in terms of their low water requirement and their adaptation to regional extreme environmental conditions (soil, disease and pest, plant nutrition, etc.).

In the literature, there are some different studies on the evaluation of natural plant taxa in landscape design; determination of drought-resistant natural species (Dilaver 2014), possibilities of use in planting design (Eroğlu et al., 2005; Deniz and Şahin, 2005; Koçan, 2010; Atik et al, 2013; Bekçi et al., 2013; Kılıçaslan and Dönmez, 2016; Tel and Akan 2021, Tırnakçı and Aklıbaşında 2023), landscape value of natural species with ethnobotanical features (Sarı and Öztürk, 2023).

A large part of the Central Anatolia Region is adversely affected by drought in the summer months. The supply of both drinking and irrigation water in urban areas is sometimes difficult, and even the water required for the maintenance of these areas may not be met. At this point, it is very important in terms of sustainability to include natural plant species instead of exotic plant

species with high water demand in the creation of green areas.

In xeriscape applications; large grass surfaces should be kept to a minimum and plants with high drought tolerance should be preferred (Hersek and Korkut, 2021). In this context, Nevşehir, which is located in the Iran-Turanian phytogeographic region, has a rich steppe and mountain-steppe flora resistant to drought. It is a positive situation in terms of xeriscape that 5 taxa (13%) of the selected plant species have high water demand, 1 taxon (2%) has medium water demand, and 34 taxa (85%) have low water demand. Therefore, it is recommended that future plantings in the region should include more native plant taxa with high drought tolerance. Because by preferring natural plant species in plant designs; habitat is created in urban areas, natural plant diversity is preserved, maintenance and repair costs are reduced (fertilization, spraying, irrigation) and urban identity is strengthened.

In recent years, with the increase in dry periods experienced in certain periods in our country, xeriscape arrangements have gained importance. At this point, this study is important in terms of drawing attention to the importance of the use of natural plant taxa in xeriscape applications in Nevşehir.

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Chapter 4

RAINWATER MANAGEMENT MODEL IN FENER CAMPUS IN RECEP TAYYIP ERDOGAN UNIVERSITY

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INTRODUCTION

Water is one of the fundamental building blocks for the sustainability of ecosystems and the continuity of human life (Chaplin, 2001; Özsoy, 2009). Water, which has a wide range of uses from drinking water supply to agricultural production, from energy generation to industry, is also considered a strategic resource that determines the economic development and welfare levels of societies (Akın & Akın, 2007; Westall & Brack, 2018; Kılıç, 2020). However, the pressures on water resources, which are vital for the life cycles of different ecosystems and all living beings, especially humans, are increasing at local, national, and global scales. As a result of these pressures on water resources, pollution of water sources, disruption of the water cycle, and the rise in temperatures along with changing precipitation patterns due to climate change are becoming more prevalent. Moreover, climate-related hazardous weather events and disasters, harmful to ecosystems, are increasing (Yüksek, 2016), significantly affecting the amount, temporal, and spatial distribution of water resources. These changes pose a threat to existing water management strategies and make it increasingly difficult to manage water sustainably (Şen, 2005; Kasim et al., 2014).

Today, the protection and management of water resources, as well as adapting them to the impacts of climate change, have become one of the fundamental priorities for environmental and economic sustainability at both local and global levels (Butts, 1997; Doğan & Tüzer, 2011; Yılmaz, 2015). Climate change has direct impacts on the basic components of the water cycle. Unpredictable fluctuations in precipitation patterns cause imbalances in the spatial and temporal distribution of water, while the frequency of extreme events such as droughts and floods is increasing (Change, 2001; Öztürk, 2002; Yaşar Korkanç & Korkanç, 2006; Çakmak & Gökalp, 2011; Change, 2014; Yüksek & Yüksek, 2016; Demirbaş & Aydın, 2020). The disruption of seasonal precipitation regimes and the increase in short-duration, intense downpours not only increase the risk of floods and inundations but also exacerbate problems such as water scarcity and drought, making these issues more complex.

University campuses, with their large areas and high water consumption, offer great potential for implementing sustainable water management strategies (McHugh, 2011; Helling & Bölsche, 2021; Li et al., 2022; Oğuztürk & Pulatkan, 2022). Additionally, these areas provide ideal environments for conducting scientific research and experiments, and they serve as pilot sites where innovative solutions related to sustainable water management can be tested (Jack & Kelly, 2012; Teston et al., 2018; Niu et al., 2023). For instance, universities such as Oregon University (USA), Waterloo University (Canada), Alcalá University (Spain), and Boğaziçi University (Turkey) have developed and implemented innovative approaches to water management within their campuses (Gezici & Keskin, 2023; Ercan Oğuztürk & Pulatkan, 2023).

Rize province, being one of the regions in Turkey with the highest rainfall, holds particular importance for observing the impacts of climate change and managing water resources. The region's geographical structure, steep terrain, and highly rainy climate make water management quite complex. Intense and sudden rainfall in Rize increases the risk of floods and inundations not only in rural and agricultural areas but also in urban centers. This situation challenges the infrastructure systems and hinders the efficient management of water (Yüksek, 2011; Yüksek, 2017; Polat & Sunkar, 2017).

This study aims to analyze the water accumulation caused by climate change and its effects on water management at Recep Tayyip Erdoğan University (RTEU) Central (Fener) Campus in Rize province. In the study, the accumulation of water, surface runoff, and drainage problems in the campus area were examined, and the effectiveness of the existing water management infrastructure was evaluated. The primary goal of the study is to determine the adequacy of the campus's water management infrastructure under the impact of climate change and to propose solutions for the water accumulation issues. The development of climate-adaptive water management strategies and the improvement of the existing infrastructure systems on the campus to make them climate-resilient are of great importance for the sustainable management of water resources in the region (Wild et al., 2017; O'Hogain et al., 2018; Keesstra et al., 2018; Krauze & Wagner, 2019; Oral et al., 2020).

MATERIALS AND METHODS

Materials

This study was carried out to evaluate the current state of water management and the impacts of climate change in the campus area of Recep Tayyip Erdoğan University (RTEU) in Rize province (Figure 1). In the study, AutoCAD base maps, satellite images, and field photographs of the RTEU Central (Fener) campus were used to assess the current situation and conduct various calculations. In addition, some climate data for Rize province covering the years 1928-2023 (URL1) and Google Earth Pro software were also used as research materials.

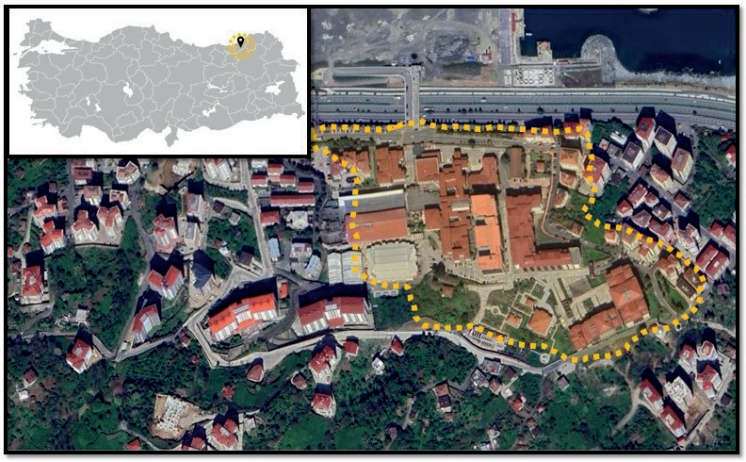

Figure 1. Location Map of the Study Area

Method

The data used in the research and the methods of data collection are presented in Table 1.

Table 1. Type of Data and Data Collection Method

Type of Data	Data Collection Method
Water management issues at RTEU Central (Fener) Campus	Field studies were conducted on different dates within the campus, and water management issues were identified and documented through photographs.
Roof Areas within the Campus	Roof surface areas were calculated using AutoCAD software.
Amount of runoff from roofs	Data from Rize province between 1928-2023 were used.
Current value of runoff from roofs	The value was calculated based on the price of 1m³ of water used in homes as of October 2024, provided by Rize Municipality.

FINDINGS

No existing Campus Water Management model was found to be currently implemented at Recep Tayyip Erdoğan University. A total surface area of 25,943 m², consisting of 21 different points where water harvesting can be conducted, was identified within the campus and the adjacent university housing areas (Figure 2).

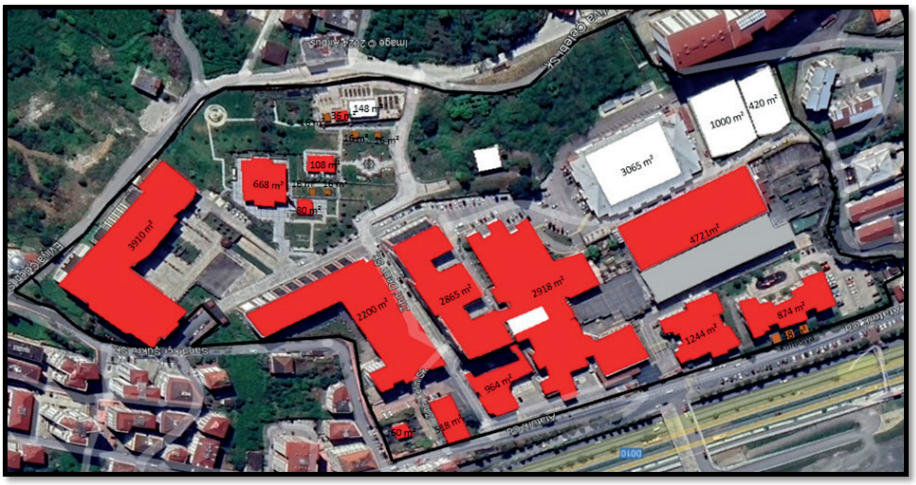

Figure 2. Buildings and Surface Areas Suitable for Water Harvesting

The largest roof surface area available for water harvesting within the campus is 4721 m^2 at the MMF-Student Life Center, while the smallest roof surface area is 16 m^2 at the pavilions within the area. Based on the 95 years of rainfall data from 1928 to 2023, the amount of surface runoff and harvestable water from the roofs of the buildings on campus is 59,474.19 m^3 annually. Taking into account the 2024 water price for households in Rize municipality (13.13 lira per 1 m^3), the market value of the harvestable water is 780,896.18 lira (22,799.89 USD, with 1 USD equal to 34.25 lira) (Table 2). The highest water runoff occurs in October with 7,635.02 m^3, and the lowest runoff occurs in April with 2,490.53 m^3. During the vegetation period (April 1 to November 30), the runoff from roof surfaces amounts to 38,190.56 m^3, representing 64.21% of the total runoff. Seasonally, the highest water runoff occurs in autumn with 35.18%, while the lowest runoff occurs in spring with 15.42% (Table 3).

Table 2. *Roof Surface Areas of Buildings at RTEU Fener Campus and Potential Runoff Water from Roofs*

Areas	Roof Surface Area (m^2)	January	February	March	April	May	June	July	Augusts	September	October	November	December	TOTAL
Basketball court	1000	230,80	185,90	161,40	96,00	96,20	134,90	151,20	0,19	257,60	294,30	254,50	242,30	2.105,29
Mosque	668	154,17	124,18	107,82	64,13	64,26	90,11	101,00	130,19	172,08	196,59	170,01	161,86	1.536,40
Tea house	108	24,93	20,08	17,43	10,37	10,39	14,57	16,33	21,05	27,82	31,78	27,49	26,17	248,40
Building	60	13,85	11,15	9,68	5,76	5,77	8,09	9,07	11,69	15,46	17,66	15,27	14,54	138,00
Faculty of Science and Letters Building	2865	661,24	532,60	462,41	275,04	275,61	386,49	433,19	558,39	738,02	843,17	729,14	694,19	6.589,50
Faculty of Economics Building	2200	507,76	408,98	355,08	211,20	211,64	296,78	332,64	428,78	566,72	647,46	559,90	533,06	5.060,00
Faculty of Theology Building	3910	902,43	726,87	631,07	375,36	376,14	527,46	591,19	762,06	1.007,22	1.150,71	995,10	947,39	8.993,00
Indoor Sports Hall	3065	707,40	569,78	494,69	294,24	294,85	413,47	463,43	597,37	789,54	902,03	780,04	742,65	7.049,50
Residential Building	874	201,72	162,48	141,06	83,90	84,08	117,90	132,15	170,34	225,14	257,22	222,43	211,77	2.010,20
Residential Gazebos	48	11,08	8,92	7,75	4,61	4,62	6,48	7,26	9,36	12,36	14,13	12,22	11,63	110,40
Guesthouse	518	119,55	96,30	83,61	49,73	49,83	69,88	78,32	100,96	133,44	152,45	131,83	125,51	1.191,40
Faculty of Engineering and Architecture/ Student Life Center	4721	1.089,61	877,63	761,97	453,22	454,16	636,86	713,82	920,12	1.216,13	1.389,39	1.201,49	1.143,90	10.858,30
Greenhouse Office Building	36	8,31	6,69	5,81	3,46	3,46	4,86	5,44	7,02	9,27	10,59	9,16	8,72	82,80
Greenhouse gazebo	16	3,69	2,97	2,58	1,54	1,54	2,16	2,42	3,12	4,12	4,71	4,07	3,88	36,80
Gazebo around the greenhouse	80	18,46	14,87	12,91	7,68	7,70	10,79	12,10	15,59	20,61	23,54	20,36	19,38	184,00
Greenhouse	148	34,16	27,51	23,89	14,21	14,24	19,97	22,38	28,85	38,12	43,56	37,67	35,86	340,40
Faculty of Fisheries	1244	287,12	231,26	200,78	119,42	119,67	167,82	188,09	242,46	320,45	366,11	316,60	301,42	2.861,20
Ablution Fountain	80	18,46	14,87	12,91	7,68	7,70	10,79	12,10	15,59	20,61	23,54	20,36	19,38	184,00
Rectorate Building	964	222,49	179,21	155,59	92,54	92,74	130,04	145,76	187,88	248,33	283,71	245,34	233,58	2.217,20
Tennis court	420	96,94	78,08	67,79	40,32	40,40	56,66	63,50	81,86	108,19	123,61	106,89	101,77	966,00
Foreign Languages Building/Library	2918	673,47	542,46	470,97	280,13	280,71	393,64	441,20	568,72	751,68	858,77	742,63	707,03	6.711,40
	Total (m^3)	5.987,64	4.822,80	4.187,20	2.490,53	2.495,72	3.499,71	3.922,58	4.861,59	6.682,92	7.635,02	6.602,49	6.285,99	59.474,19
Current value (Turkish Lira)		78.617,77	63.323,41	54.977,94	32.700,63	32.768,76	45.951,20	51.503,50	63.832,62	87.746,70	100.247,88	86.690,74	82.535,03	780.896,18
Current value (Dollar)	25943	2.295,41	1.848,86	1.605,20	954,76	956,75	1.341,64	1.503,75	1.863,73	2.561,95	2.926,95	2.531,12	2.409,78	22.799,89
	Percentage	10,07	8,11	7,04	4,19	4,20	5,88	6,60	8,17	11,24	12,84	11,10	10,57	100,00

Table 3. *Seasonal Variation of Surface Runoff Water from Roofs*

Seasons	Surface Runoff Water (m³)	Surface Runoff Water (%)
Spring	9.173,45	15,42
Summer	12.283,88	20,65
Autumn	20.920,43	35,18
Winter	17.096,43	28,75
TOTAL	59.474,19	100,00

Rainwater, reaching both roofs and other open areas, particularly hard surfaces within the campus, leads to surface runoff in areas with the highest user density (Figure 3), causing various issues. The surface runoff length in areas with the highest user density within the campus ranges from 135 to 310 meters (Table 4).

Figure 3. *User Density and Surface Runoff Points within the Campus*

Table 4. *Surface Runoff Distance in High Access Areas of Fener Campus (m)*

Flow	Flow Location	Flow Length (m)*
Flow-1	Greenhouse Corner - In Front of the Rectorate	310
Flow-2	From Between the Faculty of Science and Letters and the Faculty of Economics and Administrative Sciences to the Front of the Rectorate Building	208
Flow-3	School of Physical Education and Sports (BESYO) Corner - Main Entrance Gate	203
Flow-4	From the Flagpole Area to the Main Entrance Gate	135

*: Flows over 100 meters have been taken into consideration.

Rainwater runoff from building roofs within the campus is frequently discharged near building foundations or onto walkways (Figure 4). These faulty drainage practices have led to accessibility issues at various points within the campus, where water accumulation is significant, increasing the risks of slipping, falling, or near falls (Figure 5). Additionally, runoff from rainfall has resulted in various types of pollution on hard surfaces, negatively impacting the aesthetic quality of the campus (Figures 4, 5, 6, 7), while valuable rainwater leaves the campus unused. Furthermore, after snow melts and the resulting water refreezes, certain areas within the campus have been identified as high-risk zones for slipping (Figure 6). Another critical issue is the ongoing risk of slipping caused by algae growth on hard surfaces due to rainwater (Figure 7).

Figure 4. *Discharge of Roof Water onto Pedestrian or Walkways*

Figure 5. *Water Accumulation, Eutrophication-Algae Growth, and Slipping Risk on Walkways Due to Faulty Drainage*

Figure 6. *High-Risk Areas for Slipping on Walkways Due to Snowmelt and Refreezing of Melted Snow Water*

Figure 7. *Slippery Conditions Caused by Algae Growth on Hard Surfaces Due to Rainwater*

DISCUSSION

Water is of vital importance for the survival of all living beings, especially humans, and for the sustainability of various ecosystem services. Despite the limited availability of water resources that can be used for different purposes at local, national, and global scales, the demand for these resources continues to increase with the growing population. As the population increases, the amount of consumable water per capita rapidly decreases (Yüksek, 2004). On the other hand, climate change-related water issues, including extreme rainfall, floods, droughts, water pollution, and transboundary waters, continue to rise rapidly on a global, national, regional, and even local scale. Recent studies have revealed many water-related problems within university campuses. In particular, issues such as the inability to properly manage water flow on campuses (McHugh, 2011; Helling & Bölsche, 2021; Li et al., 2022) and water accumulation in low-lying areas indicate that current drainage systems are inadequate in coping with heavy rainfall. Blockages in rainwater drainage systems and the inability to control the direction of water flow (Jack & Kelly, 2012; Teston et al., 2018; Niu et al., 2023) have led to disruptions in campus transportation and damage to infrastructure (Tuna, 2006; Markovi et al., 2014; Xu et al., 2018; Bayramoğlu & Büyükkurt, 2020). Therefore, it is crucial to develop and implement water management models in relevant units to solve any water-related issues accurately. In this regard, there is a need for university water

management models to ensure the proper execution of water conservation, water harvesting, precipitation-runoff balance, and wastewater recycling on university campuses.

In this study, the problems caused by surface runoff on the RTEU Fener campus were closely observed, and climate-adaptive water management strategies were discussed. The findings indicate that the existing infrastructure systems should be reviewed, necessary adjustments and renovations should be made in problematic areas, and new water management approaches should be adopted. In this context, reorganizing the water management strategies on campus, harvesting rainwater for use within the campus, and implementing nature-based solutions (such as rain gardens, permeable surfaces, and water retention ponds) are recommended to create a climate-resilient water management infrastructure (Türkeş et al., 2000; Sağlam et al., 2008; Çorbacı et al., 2011; Wild et al., 2017; O'Hogain et al., 2018; Keesstra et al., 2018; Krauze & Wagner, 2019; Oğuztürk & Bayramoğlu, 2020; Oral et al., 2020; Qi et al., 2020; Güneroğlu & Pulatkan, 2021).

Although this study focuses solely on the campus area, it also provides valuable insights into water management for other areas with heavy rainfall, such as Rize. The data obtained reveal the inadequacies of current water management approaches under climate change scenarios and highlight the need for strategic planning to sustainably manage water resources in the long term. Rize province, being one of the rainiest regions in Turkey, holds particular importance for observing the impacts of climate change and managing water resources. The region's geographical structure, steep slopes, and heavy rainfall make water management quite complex. Intense and sudden rainfall in Rize increases the risk of floods and inundations, not only in rural areas but also in urban centers. This situation challenges infrastructure systems and hinders the efficient management of water (Yüksek, 2017; Polat & Sunkar, 2017).

CONCLUSION AND RECOMMENDATIONS

Observations made at the RTEU Fener campus and long-term climate data reveal that the current water management infrastructure is inadequate in adapting to changes in rainfall patterns. Increases in rainfall amounts and the frequency of sudden rainfall events are leading to water accumulation problems on the campus. The existing drainage and discharge systems are not resilient to such extreme weather events, resulting in surface runoff and the formation of water pools, which pose various risks in certain critical areas within the campus. Another significant issue is the failure to capitalize on the potential economic value of the rainwater within the campus.

Recommendations

Campus Water Management Coordination Unit: A Campus Water Management Coordination Unit should be established to ensure the proper management of water within the campus (Figure 8). Utilizing artificial intelligence in the campus water management model and sharing the knowledge and experiences gained with other stakeholders can provide significant contributions to sustainable water management.

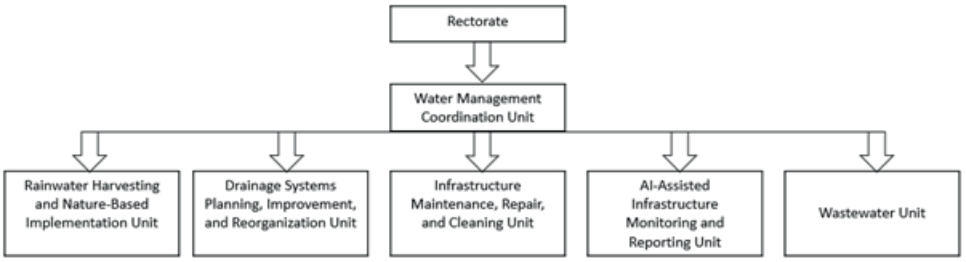

Figure 8. Example of Management Scheme

Improvement and Reorganization of Drainage Systems: The water drainage systems and channels within the campus should be reorganized to accommodate the increasing rainfall and respond to future precipitation levels. In particular, larger capacity drainage channels should be constructed in low-lying areas where water accumulation frequently occurs.

Monitoring, Maintenance/Repair, and Cleaning of Existing Infrastructure Systems: To prevent frequent blockages and water accumulation in the campus infrastructure, regular maintenance and cleaning operations should be conducted. This will be beneficial for campus water management and reducing water-related risks.

Rainwater Harvesting and Nature-Based Solutions: Rainwater harvesting should be planned and managed on a unit basis (e.g., the Faculty of Fisheries). During planning, the potential rainwater harvesting capacity of each unit should be considered, and the harvested water should be used primarily to meet the unit's needs (cleaning of corridors, classrooms, laboratories, restrooms, etc.). Once the harvested water is depleted, the units should switch back to municipal water until more rainwater is harvested. To prevent water accumulation within the campus, nature-based solutions such as rain gardens, permeable surfaces, and water retention ponds can be implemented. These types of applications can help slow down surface runoff and allow water to be absorbed naturally, while also preventing the formation of local heat islands and contributing to the sustainability of climate comfort on campus.

Development of Climate Change Adaptation Strategies: To solve long-term water management issues and adapt to climate change within the campus, climate-resilient infrastructure projects should be planned, and water management policies should be developed and updated according to evolving needs.

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Chapter 5

SPACE AND HUMAN REPRESENTATION IN MINIATURE ART: THE OTTOMAN EMPIRE-MATRAKCI NASUH WORKS

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1.Introduction

In Western languages, the term "miniature," which denotes a small-scale representation of an object, has evolved to describe the illustrative small images drawn to the margins of books. In Latin, it means painting in red and has been translated into Turkish as 'minyatür' (miniature). They are descriptive images placed on manuscripts to elucidate the text. Dating back to antiquity in the West and to pre-Islamic times in the East, this art form was widely practiced throughout the Middle Ages. With regard to the Islamic world, it developed in conjunction with the art of calligraphy and retained its popularity from the 13th century to the 18th century (Konak, 2014; Renda, 1997). In brief, in the West, this term denotes the act of painting in red, whereas in the East, it signifies the addition of elucidating and explanatory images to written texts. The fact that the meaning attributed to the word is different, means that this art can be practiced in different ways in different cultures. A review of the historical development of miniature art reveals that it originated in the East and subsequently spread to the West. The earliest known examples of miniature works were discovered in ancient Egypt during the 2nd century BC on paper called papyrus. Following its initial appearance in Egypt, it is known to have spread to the Greeks, Romans, Byzantines, and Japanese. Iran and India, two distinct geographical regiones, are among the countries that have produced the most miniature works (Figure 1-2).

Figure 1-2. Miniature examples from Iran and India respectively (The Met Museum - Pinterest -1).

The general characteristics of miniature art can be examined under the headings of subject, line and perspective.

The subjects covered vary according to the content of the books. How-

ever, when an evaluation is made, it is seen that Turkish miniatures generally concentrated on four subjects: landscapes, portraits, events and scientific subjects. Among these subjects, miniatures depicting events are the most common. Landscape was used as a background on which the event was placed in the miniature. It is usually seen as a few hills or plains. However, if the subject is solely landscape, detailed features such as rivers, bridges and castles are reflected in the miniature. Such miniature examples are drawn from a bird's eye view (Keskiner, 2004).

In simple terms, a line is defined as the trace of a point moving on a surface. The element that brings the line to the fore is color. The color factor, which makes the work stand out, is the element that occupies the largest space in the work. Lines, i.e. color, are thin and elegant. The technique seen in Turkish miniatures is based on the outer contoured pattern system (Kahraman and Önal, 2020). Gilded paint is often used for coloring.

Perspective is a painting and drawing technique for creating the illusion of a third dimension by depicting three-dimensional realities on a two-dimensional picture plane. It was not utilized in Turkish miniature art in this form. For this reason, neither the objects nor the figures in the miniature are arranged in such a way that they come behind each other or cover each other. However, although perspective was not employed, the depth of miniature works could be described by the position of the elements relative to each other. In works where both foregrounds and backgrounds are depicted, the foregrounds are positioned at the bottom, while the backgrounds are placed at the top. There is no distinction in height or color between the two sections, ensuring that they possess equal characteristics throughout the composition (Kibar, 2014; Yetkin, 1953), (Figure 3).

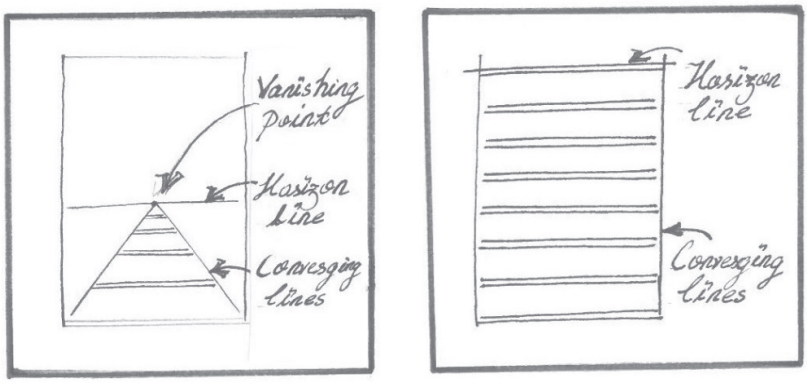

Figure 3 Perspective in Painting and in Miniature respectively (Konak, 2001).

Another crucial topic in miniature is the concept of space. Space can be imagined as an infinite magnitude that encompasses all limited magnitudes in which beings take place; emptiness and nothingness. It is defined as an unlimited environment, an infinitely large container or reservoir, and a three-dimensional occupation (Konak, 2014; Cevizci, 1999).

Space is rendered in painting by creating and positioning the elements that make up the composition, together in such a way as to create the illusion of the third dimension. Upon examination of the examples of miniature art, it becomes evident that the artists do not fully adhere to the visible reality during the design process. Instead, they reflect the space by depicting the objects within it, rather than the space itself. In other words, in addition to the objective reality, the artist's subjective interpretation is also an element that contributes to the spatial composition.

2. MATERIAL AND METHOD

This study examined miniature works drawn by Matrakçı Nasuh, an artist of the Ottoman Empire's Suleiman the Magnificent period, the period in which the majority of the examples of miniature art were created. Matrakçı Nasuh developed a unique method of drawing called topographical depiction, which enabled the creation of bird's-eye view plans of cities. In addition to his urban plans, there are also human depictions. In this study, a selection of his works that combine both were examined to determine how his interpretations differed from the modern perception of space. The artifacts were subjected to analysis with a particular focus on their characteristics as historical documents and the symbols they contain. A total of five city depictions and four event-person depictions were analyzed and interpreted among the various works accessed.

3. FINDINGS

The miniature works produced during the Ottoman Empire period were used to document a historical event, unlike the works produced both in other countries of the period and in the entire miniature art. For this reason, it would be more accurate to use the word "depiction", which means drawing a picture, making a copy of it. Depict is derived from the Latin word 'depingere' which means to portray, paint, sketch; describe, imagine. Unlike their counterparts, the miniature works produced in the Ottoman Empire are works with depth that serve purposes such as explaining events, documenting wars, and shed light on the past in later periods as official documents (Selvi and Bekiroğlu Keskin, 2017). In this context, it can be argued that miniature works, especially from the Ottoman Empire, are not intended to be displayed on a wall for passive observation, but rather to be read in a manner similar to a book.

The most significant figure in the Ottoman Empire's miniature tradition

was Matrakçı Nasuh, who lived in Suleiman the Magnificent period. He created map-like works in Turkish miniature art reflecting the obvious topographical features of cities, and is also known as a historian, calligrapher, mathematician and swordsman. What is known about Nasuh, who was nicknamed Matrakçı thanks to his success in the Matrak game, is almost limited to this. However, it is known that he was close to the sultan in the palace, that he was friends with his contemporaries Barbaros Hayrettin Pasha and Mimar Sinan, and that he participated in expeditions and made drawings (Selvi and Bekiroğlu Keskin, 2017). He depicted castles, mosques, walls and houses in bird's-eye view miniatures that resemble a plan, as if the cities were viewed from above. In his very realistic works, he also included beautiful rural landscapes, bridges and streams. His miniature works are invaluable in terms of Turkish history, architecture, geography and urban planning.

He was the first to create the concept of "topographic depiction." He integrated the discipline of cartography into the domain of miniature painting, thereby establishing a distinctive style that imbued contemporary architecture and miniature painting with a novel perspective and vitality.

The miniature works of Matrakçı Nasuh were interpreted as follows by examining the space, people, composition and narration of events.

Miniature Depiction of Istanbul City

Illustrated city map with topographic depiction (1/2000), depicting an open space, rural and urban areas.

Matrakçı Nasuh, who embarked on an expedition from Istanbul to Tabriz with Suleiman the Magnificent between 1533 and 1536, depicted numerous cities along the route using the "topographical depiction" method. He commenced with Istanbul, the point of departure for the expedition (Encyclopedia of Islam, 2021). The right wing of the work shows the historic city walls, while the left wing shows Pera, Galata and the Golden Horn. When the details of the buildings within the city walls on the right side are examined, hundreds of buildings such as Topkapı Palace, Hagia Sophia, the historical Hippodrome (also known as Atmeydanı) where the old Byzantine Palace was located can be observed. It is evident that these structures were illustrated and documented one by one with their details. The land walls rising next to the sea on the right wing and the Galata Tower on the left wing facilitate legibility. In this work, in which the presence of perspective cannot be mentioned, it is evident that Nasuh attempted to convey almost every building he observed in a realistic manner by utilizing various viewpoints. Upon consideration of the provided details and the relevant artifacts, it can be seen to correspond to the contemporary city of Istanbul to a great extent. When examined in terms of historical document quality, it is seen that there are no such detailed architectural and map drawing works of the period. This depiction is of great importance in

terms of reflecting the space.

In addition to the positioning and defining details of the structures in the work, the trees, which appear to have been illustrated randomly, are particularly preferred for their ability to represent the plant identity at those points. Despite the absence of perspective or perceived dimension, hills that yet preserve their rural identity can be observed in the back, especially on the left wing of the work, in the Pera section. The "Historic Peninsula-Suriçi" region on the right wing, which remains the most significant urban center today, is depicted as a densely populated area with no vacant space. It can be easily interpreted that this particular peninsula has consistently retained its significance and value throughout history (Figure 4).

Figure 4. Miniature depiction of the city of Istanbul (Ministry of Culture and Tourism, 2021).

Miniature Depiction of Istulnibelgrad City

Illustrated city map with topographic depiction (1/2000), depicting an open space, rural and urban areas.

Estimated to have been drawn in 1545, the Hungarian city of Istulnibel-

grad or Estonibelgrad is another work by Nasuh in which he again utilizes the topographical depiction style (Çelikbağ and Geçen, 2019). The gilded paint of miniature art is seen in the ground drawing in this work. In this peninsula-type city, which is understood to be surrounded by water, the perception of a crammed and crowded life is reflected in the depicted scene. In the work portraying the city region, where no open space or green area is depicted, one reads rather of settlements that are adjacent to each other. In the outermost part of this island system connected by bridges, there is a rural area at a certain distance and in this area, there is a life with nomadic tents. The plant drawings are not arbitrary; rather, they serve as identifiers for specific species. Based on this, it can be postulated that the rural portion of the city is situated in more infertile soils, where biodiversity is not as prevalent. Gaps are not observed in the center of the settlement, but rather in the rural part of the city where tent settlements are located. Additionally, there is a diminished sense of security in this rural area compared to other areas (Figure 5).

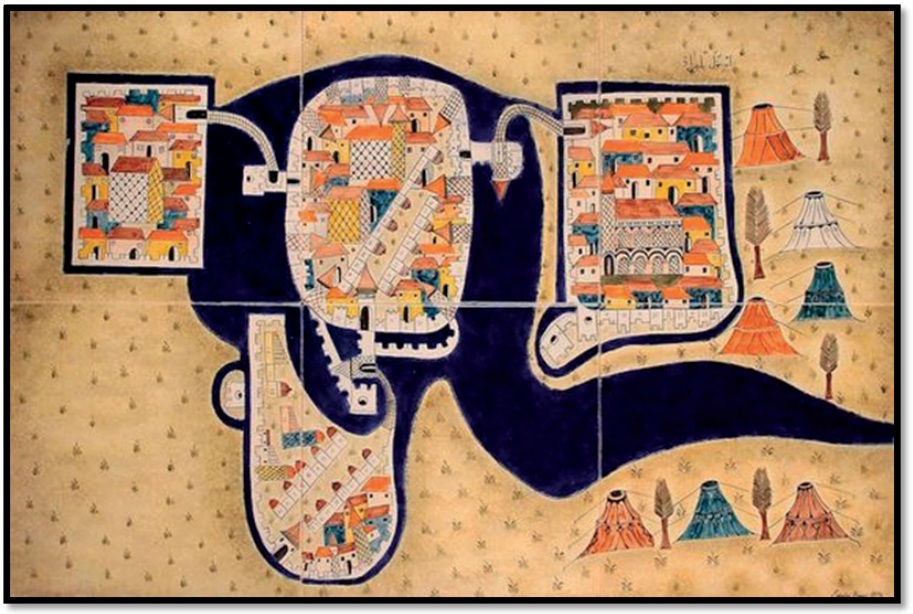

Figure 5. Miniature depiction of the city of Istulnibelgrad, Hungary (Nadir Kitap, 2021).

Miniature Depiction of Bitlis City

Illustrated city map with topographic depiction (1/2000), depicting an open space, rural and urban areas.

Bitlis is one of the oldest settlements in Anatolia. The settlement in this old city is therefore very deep-rooted, dating back to 1400 BC (Bitlis Gover-

norship, 2021). The place included in this miniature by Matrakçı Nasuh is this urban settlement between two valleys. Although the focal point is Bitlis Castle and its bastions, another striking point in the entire work is the reflection of the valleys. Despite the absence of depth and perspective, the artist was able to convey the impression that the city settlement is situated on the valley floor and encircled by tall mountains. In addition to showcasing the partially barren hills of Eastern Anatolia, the depiction also stands out with a castle dominating the settlement centers. Mosques and aqueducts can also be observed in the city, which consists of single-storey and flat-roofed houses. In the settlement area at the bottom, the part close to the viewer, one can see rivers meandering through the mountains. From the aqueducts and rivers, it is evident that the area is a wetland, in contrast to the settlement area above, the part farther from the viewer. Furthermore, the houses on either side are arranged in groups of five or seven, forming neighborhood units. In addition to perceiving the compression of the hills throughout the entire depiction, the balance between green areas and residential areas can be observed with the gaps in the settlement between the hills (Figure 6).

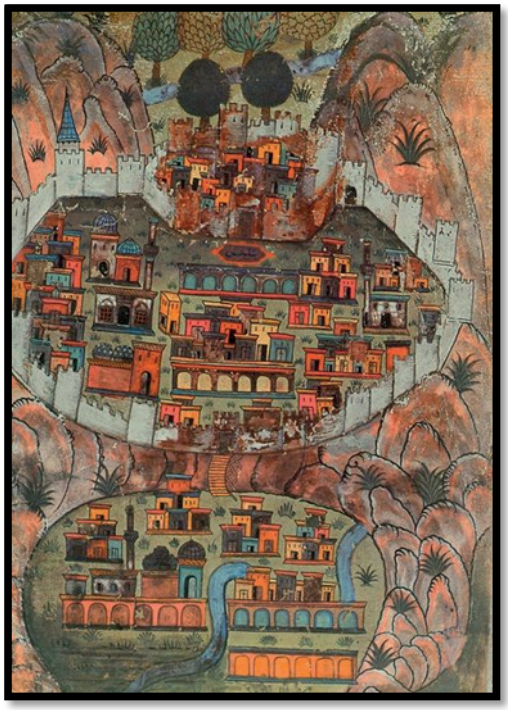

Figure 6. Miniature Depiction of Bitlis City (Yavuz Azeri, 2017).

Miniature Depiction of Aleppo City

Illustrated city map with topographic depiction (1/2000), depicting an open space, rural and urban areas.

The city of Aleppo, situated on the border of modern-day Syria, became a significant hub within the Ottoman Empire following the conquest of Yavuz Sultan Selim (Selim I). As a central point within Mesopotamia and a junction for major trade routes, the city has been home to various civilizations throughout history. In the miniature representation of this city, which literally serves as a bridge between the East and the West, the walls surrounding the city, depicted from two different viewpoints, are particularly notable. The castle, symbolizing the city's authority and influence, occupies a central position within the bazaar and the settlement. Although there is no green space in this miniature work, which reflects single-storey buildings and bedestens, the water located in the center of the city can be considered a reference to the center of life. The city reflects the perception of a strong and self-sufficient, safe space. Additionally, there is no empty space, the perception of a cramped and full space is conveyed as much as possible (Figure 7).

Figure 7. Miniature depiction of the city of Aleppo (Samarkand Foundation, 2021).

Miniature Depiction of Konya City

Illustrated city map with topographic depiction (1/2000), depicting an open space, rural and urban areas.

For the city of Konya, which is depicted from the castles on the hills to the tombs on the plains, the first thing that catches the eye is the green center within the city walls. The double-domed building in the middle of these walls is the Sultan Alaeddin Pavilion. Located in the center of a regular settlement, this pavilion also symbolizes the centrality of the administration. It is surrounded by single-storey houses. The Mevlana Tomb, situated outside the city wall to the lower right of the drawing, represents the defining feature of the space. It comprises a courtyard with a pool and a green dome. Like the majority of Central Anatolia, Konya's lands are predominantly arid, with the majority of existing trees comprising fruit trees, as this image illustrates. The river meandering through the hills can be interpreted as a symbol of tranquility and settlement around this water source. The fact that the hills are green up to a certain point and steppe after another point is a typical Central Anatolian characteristic of flora. Furthermore, at the upper portion of the paper, the green and rural hills can be observed in the distance, creating the impression that the space is vast and empty for a considerable distance (Figure 8).

Figure 8. Miniature depiction of Konya City (Mevlana Research Association, 2024).

Miniature Depiction of Barbaros Hayrettin Pasha in the Presence of Sultan Suleiman the Magnificent

Documentation of a historical event illustrated through observation (1/2000). Depiction of 7 people in a closed space, 8 people in an open space.

In this miniature depiction, the paper is divided into two parts: outside and inside. At the bottom of the drawing, the outer garden of the reception hall and the courtyard gate can be seen. There are six janissaries waiting at the gate. Only one of them (the one on the left side) is depicted in a state of calm, while the other five janissaries seem to be in a state of panic and hurry. It is perceived that the five janissaries, who are in communication with each other, are ready to act upon an order from inside. Additionally, 2 more janissaries are positioned at the gate within the courtyard. Their expressions reflect a state of panic and anxiety, akin to those observed outside the courtyard. The upper portion of the painting reveals one of the palace reception halls, where Sultan Suleiman, Barbaros Hayrettin Pasha, two janissaries, and three viziers are depicted. The viziers are prepared to receive orders, maintaing a respectful posture in the presence of the emperor. Two janissaries, positioned right behind the emperor, also demonstrate respect through their posture. The manner in which Kanuni sits and the position of his hands indicate that, even if he is not recognized, he is the dominant figure in the space. Barbaros Hayrettin Pasha, who is seated lower than Suleiman the Magnificent and admitted to the presence, is the secondary figure who can sit in the space and has an important position.

Upon examination of the space, it is seen that the courtyard and the outdoor section of the structure are depicted at the bottom, while the reception hall, or indoor portion of the structure, is shown at the top. The grass area and ceramic-coated walls in the outer courtyard are particularly distinguishable. The door, which represents the transition to the inner courtyard, provides a sense of depth despite the lack of perspective. Additionally, plants are observed within the inner courtyard. These plants, which are predominantly depicted as flowering vines, provide a glimpse of the palace garden. Furthermore, the domes of Topkapı above the reception hall at the upper level demonstrate that the hall is reflected as an interior space. It can be inferred that the hall is a closed section ith the limiting roof (Figure 9).

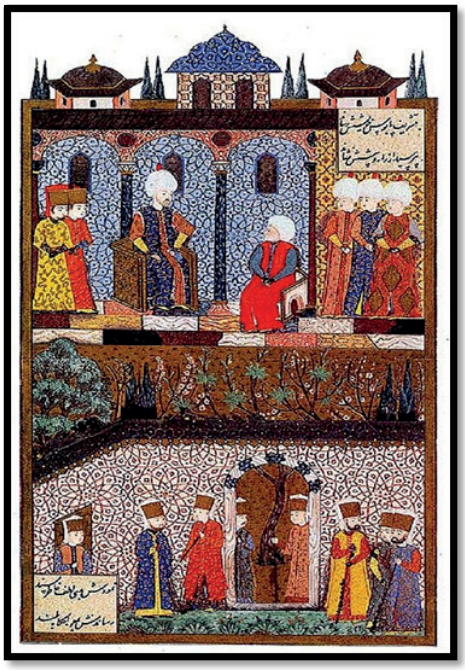

Figure 9. Miniature depiction of Barbaros Hayrettin Pasha in the presence of Suleiman the Magnificent (Greater Istanbul History, 2024).

Miniature Depiction of Sultan Suleiman's Reception of the Iranian Envoy

Documentation of a historical event illustrated through observation (1/2000). Depiction of 30 people in a semi-open space.

The reception of the Iranian envoy, which is the subject of this miniature depiction, represents one of the continuous diplomatic meetings of the state, which gradually became multiple-identity after Selim I (Selim the Resolute) annexed Iran to the empire. This event, depicted in a single space, features Sultan Suleiman, the janissaries, viziers, the Iranian envoy, and cavalry on horseback. This very crowded reception of the envoy, takes place on a pergola in the garden of the palace or pavilion. Sitting on a half-open pergola, Sultan Suleiman is at the center and in the position of the sovereign, just as he is in the empire. The Persian envoy, whom he receives, is completely prostrate on the ground as a sign of respect while greeting the Sultan. His body language reflects pudency and humiliation. The densely painted shrubs in this instance do not serve as an obvious identity plant, but rather as a screen for a hidden, concealed area. In both the vicinity of the Sultan and in front of the plant screen, janissaries are observed in a state of readiness for the order. Sultan Suleiman is also accompanied by a council of six viziers as he meets with the Iranian envoy.

This group, representing an assembly, conveys the impression that the subject under discussion is important. At the top of the paper, i.e. as we move away from the pergola, we see cavalry on horseback lined up on the right and left. Emphasizing the importance of security and the meeting, it can be interpreted that the cavalry on the left side may be the Sultan's own soldiers. Because these cavalrymen, who are waiting more orderly, have reined in their horses and are ready for an order. The cavalry on the right wing may be a team from Iran accompanying the Iranian envoy. Because they are mostly drawn as a group of soldiers who have freed their horses and spread out in a resting state. Apart from that, there is also a row of viziers in front of the Sultan's cavalry. The depiction of people positioned close to each other in this way is supportive of the idea that all the people on the left wing are those under the Sultan's command. There is also a tree positioned at the farthest and highest point. The plane tree, which best symbolizes the long life, power, and sovereignty of the Ottoman Empire over vast geographies, is depicted here in the form of a support directly behind Sultan Suleiman. In a sense, it symbolizes the Empire's authority. Additionally, an iconic Ottoman woven carpet is included. This is because, at the time, Ottoman carpets were the most traded carpets after Persian carpets. The inclusion of a carpet in this depiction may be a reference to the Iranian envoy (Figure 10).

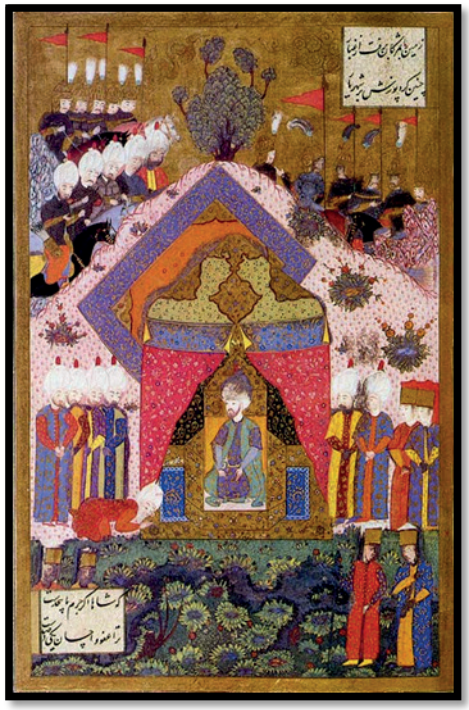

Figure 10. Miniature Depiction of Sultan Suleiman's Reception of the Iranian Envoy (Pinterest-2, 2021).

Miniature Depiction of Sultan Suleiman's Enthronement Ceremony

Documentation of a historical event illustrated through observation (1/2000). Depiction of 144 people in open space.

The most significant ceremony within the Empire is the enthronement ceremony. This ceremony marks the ascension of a new sultan to the throne, replacing a deceased or deposed predecessor. First, the throne is brought in front of Babussaade. Then, the Sultan arrives with permission and sits on the throne. In accordance with the ranking order, each statesman expresses their respect by kissing the Sultan's skirts. This ceremony indicates that the new emperor is recognized and accepted by the empire, and the Sultan does not sit on the throne at this gate until the next eid or wedding (Gökdaş and İnaç, 2014). This miniature depicts Sultan Suleiman's enthronement ceremony after the death of his father Selim I (Selim the Resolute). The left wing depicts the outer courtyard of the Babussaade, while the right wing depicts the inner courtyard where the throne was placed. The left wing shows the cavalry and janissaries waiting for their turn and for the inner courtyard to be emptied. On the right wing, the viziers and the grand vizier are observed in the order of their rank as they are brought into the presence of the sultan and await their turn to pay their respects. In consideration of the fact that the entire state dignitaries were in attendance on that day, the commencement of a lengthy and crowded ceremony is depicted. The entire ceremony appears to take place in the courtyard of the palace, an open space is depicted. Boundaries are marked by the walls of the palace, yet the open space is still felt. The left wing is particularly crowded and chaotic. Every spot is filled with people or horses, reflecting both the crowdedness of the space and the importance of the ceremony. In contrast, the right wing exhibits greater order. This is because otherwise is considered as being inappropriate in the presence of the Sultan. The left wing, is devoid of any other space except the road in the crowded outer courtyard. Additionally, a solitary tree is situated at the outermost gate. However, on the right wing, the inner courtyard displays a greater prevalence of green and grass areas. The order and spaciousness of the garden of Topkapı Palace is also noteworthy on the right wing, where order dominates (Figure 11).

Figure 11. Miniature Depiction of Sultan Suleiman's Enthronement Ceremony (Greater Istanbul History -2, 2024).

Miniature Depiction of the Rhodes Expedition

Documentation of a historical event illustrated through observation (1/2000). Depiction of 29 people in an open space.

The island of Rhodes, which had been plaguing the Empire with piracy for an extended period at that time, is one of the largest and most important islands in the Aegean. Conquered with a large navy, the island was annexed to the Empire in 1522 (Doğan, 2013). This miniature depicts the final act of surrender at the gate of Rhodes Castle. Inside the castle, the knights on the opposing side of the battle exhibit anxiety and fear. On the other hand, the Ottoman army outside the gate is depicted as more confident but exhausted with the final move. In order to better convey the crowdedness of the soldiers of the Ottoman army, which depicts a brigade of mounted cavalry and riflemen; the headpieces of the soldiers, part of their heads or their horses were drawn in the frame of the painting. This technique evokes the impression of a crowded environment. In this miniature, which portrays a military expedition and conflict, this sensation is particularly evident in the facial expressions of the depicted individuals. Regardless of the sides, a sense of terror can be observed in all of them (Figure 12).

Figure 12. Miniature depiction of the Rhodes Expedition (Pinterest 3, 2021

4.CONCLUSION

Miniature art is an important branch of art that is created with a distinct purpose in contrast to its counterparts. Following its point of origin in Egypt, the practice had spread and works have been produced in all Eastern and Far Eastern countries, including our country's history. The aim of this practice is to "photograph and document" an event or an important person at that moment. The reason for its limited openness to interpretation and criticism is that it reflects reality to this extent. Miniature depictions based on real events, as previously mentioned, are not works to be thought about and commented on or watched; rather, they are works of historical document quality to be used as a reference. It can be stated that it is an intriguing aspect of this art form to create works that are so closely aligned with reality without employing the concept of depth and three dimensions, which are the most significant indicators of reality.

The Ottoman Empire is one of the most important and powerful states in world history, having spread over 3 continents for 600 years. The period during which its star shone brightest and its influence reached its zenith was during the reign of Suleiman the Magnificent. In this period, with the strength

of the previous empires that nourished it, further steps were taken and these steps bore fruit successfully in every branch. Matrakçı Nasuh, the most popular miniature artist of this period in which significant artists were trained, signed many important works that shed light on the whole history.

It is seen that he created pioneering works in a multitude of disciplines, including history, geography, architecture, landscape architecture, cartography, and botany. Matrakçı Nasuh, who developed valuable perspectives and methods of expression in the field of cartography and urbanism, depicted the ceremonies and expeditions he attended throughout his life. He even listened to those he could not attend, painted them through imagination, had them approved by the people he listened to, and then presented them to the Sultan.

The examination of the miniature depictions reveals that the city sections that are "photographed" despite the lack of depth and three dimensions are very impressive. The details that can be obtained with today's photography technique, remote sensing systems, and aerial images are documented in the most realistic way possible with the inadequate conditions of centuries ago.

With "drawing interpretation", which is a different method of analysis and reading, the depiction of space and people in history reflects the reality and the details given convey historical scenes that we may not be able to portray so realistically.

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Chapter 6

FORMULATING SECTORAL DEVELOPMENT STRATEGIES WITH STAKEHOLDER CONTRIBUTIONS: A STUDY ON THE YEŞİLIRMAK BASIN LANDSCAPE ATLAS

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INTRODUCTION

Under the European Landscape Convention, signed by Türkiye on 20 October 2000 and effective internationally from 1 March 2004, each member state commits to identifying its landscapes, documenting their characteristics, addressing the forces and pressures affecting them, recording changes, setting landscape quality objectives, and creating policies to protect, manage, and plan landscapes. In this context, the Yeşilırmak Basin Landscape Atlas Project serves as a foundation for developing a national landscape database and the "National Landscape Strategy and Action Plans," under the Ministry of Forestry and Water Affairs, the leading agency in charge of implementing the convention. The landscape atlas was produced as a significant output of this project.

The project unfolded in three main stages: (1) study, inventory, evaluation, and the preparation of a landscape database; (2) analysis of landscape functions, indicators, and character evaluation; and (3) the development of sectoral landscape guides and the landscape atlas. The project began on 31 October 2012 and concluded on 20 April 2015. The initial kick-off meeting was held in Amasya in 2013, followed by workshops in Samsun, Tokat, and Çorum during 2013 and 2014, which included the participation of relevant public bodies, non-governmental organizations, and local communities. A training session was held in Ankara in 2014, with the final closing meeting in December 2015. The Yeşilırmak Basin Landscape Atlas Project was also assessed during the 6th session of the Council of Europe Landscape Award for 2018-2019, which is organized by the Council of Europe and presented biennially.

The Landscape Atlas serves as a critical tool for shaping strategies that balance the protection and use of a nation's landscapes (land use), providing key data and information to decision-makers across various sectors. It supports the integration of landscape planning approaches into sectoral plans—such as those for urbanization, conservation, forestry, agriculture, and industry—consistent with the principles of the European Landscape Convention. The objectives of the Yeşilırmak Basin Landscape Atlas include evaluating landscape character (functions, changes, pressures, and quality), identifying landscape character types and areas, assessing landscape diversity and biodiversity, and producing a landscape quality map. Additionally, it seeks to develop strategies for landscape protection and development and to prepare sector-specific landscape guides.

The Landscape Atlas, at both regional and national levels, enables the identification of landscape and biological diversity across basins. It contributes to building a biological diversity and landscape inventory database, supporting the development of a "Landscape Information System." The atlas also features the creation of landscape quality maps at the basin level, along with strategies for landscape protection, development, and sectoral landscape guides.

Its methodology is grounded in the principles of rationality, holism, and sustainability. As such, the atlas serves as a crucial tool for providing direction, supporting decision-making, controlling, assessing, and monitoring the implementation of these principles.

As part of the "Yeşilırmak Basin Landscape Atlas" Project, it is proposed to establish "Sub-basin Committees" organized around the sub-basins. These committees will include key sectors responsible for implementing the project's methodology in the study area. This study highlights the "participatory approach" phase, where groups from various sectors in the Yeşilırmak basin and its sub-basins form sectoral stakeholder committees. Their perspectives are incorporated into the decision-making processes at the sub-basin level. This chapter, an output of the Yeşilırmak Basin Landscape Atlas Preparation Project, centers on stakeholder analysis and sectoral development strategies for agriculture, forestry, and tourism.

MATERIAL AND METHOD

Material

Türkiye is home to 25 hydrologic basins (fig. 1), with the Yeşilırmak Basin being the 6th largest, covering approximately 3,956,798 hectares, which represents 5% of the country's total area (fig. 2). Spanning a length of 519 km, the Yeşilırmak River is the second longest river in Türkiye. The basin encompasses 11 provinces, namely Tokat, Samsun, Amasya, Çorum, Sivas, Yozgat, Gümüşhane, Giresun, Erzincan, Ordu, and Bayburt. It includes 4 key city centers (Tokat, Samsun, Amasya, and Çorum), 55 districts, and 194 municipalities.

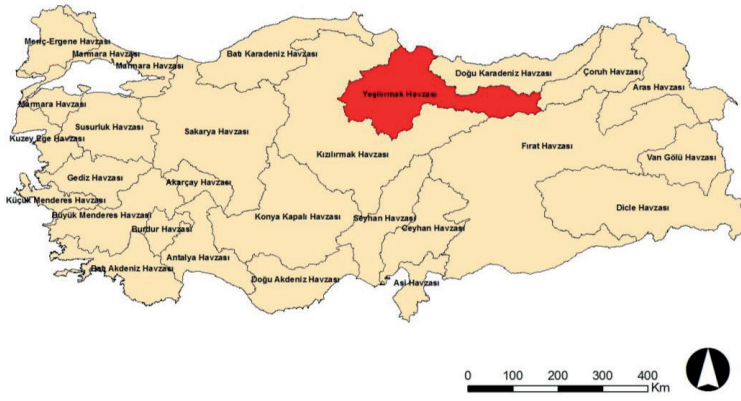

Figure 1. *Hydrological basins of Türkiye*

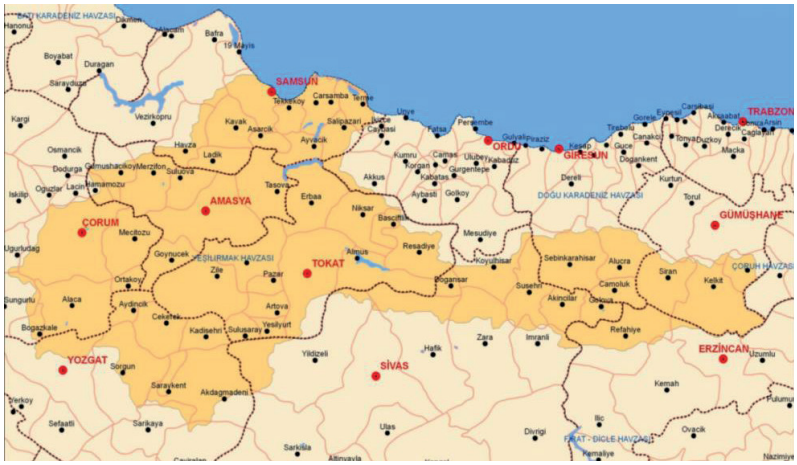

Figure 2. *Yeşilırmak Basin borders*

In the literature review conducted for the Yeşilırmak Basin Landscape Atlas Project, materials included scientific journals, TÜBİTAK project reports, Ministry project reports, research conducted or commissioned by public institutions, planning studies and projects, officially validated statistical evaluations, and information aligned with academic research related to the project.

Method

Within the scope of the project, the current situation was elucidated through the utilization of information gathered from literature reviews, data accessible or transferred via digital platforms, information and data provided by relevant institutions and organizations, as well as field studies, meetings, and observations conducted within the basin. Additionally, visual materials were employed to support this analysis.

In the formulation of sectoral development strategies, stakeholders from the agriculture, forestry, and tourism sectors in the basin were identified. The interests, priorities, behaviors, and values of each stakeholder were analyzed, and common goals and objectives were established.

Stakeholder analyses and surveys were conducted to identify all stakeholders who may be impacted by existing issues or the outcomes of the ongoing project, as well as to assess the relationships, strengths, and influence of these stakeholders on the project, and to define strategies for their participation.

All stakeholders identified within the scope of the project were invited to meetings and workshops. In addition, representatives of stakeholders participated in the training organized after the production of the Atlas. In all participatory events, information was shared about the European Landscape Con-

vention, the rationale for preparing the Yeşilırmak Landscape Atlas, and the three main stages of the project. Detailed information was provided about the sectoral landscape guides, and their contributions were collected. The opinions and thoughts of all accessible participants, both at the central and local levels, were integrated into the project. Additionally, a survey was conducted in Samsun, Tokat, Amasya, and Çorum to assess the attitudes and perspectives of the local communities.

The number of survey participants and the locations where the survey was conducted were determined using population data from the provinces and districts of Samsun, Tokat, Amasya, and Çorum, which are known as the TR83 region, through the 'Systematic Sampling Method' within the Yeşilırmak Basin. The survey was administered randomly and on a voluntary basis. During the interviews, efforts were made to ensure similar representation of both genders. A total of 411 interviews were conducted. The fieldwork began in Samsun and was subsequently completed in Tokat, Amasya, and Çorum. The survey results were analyzed using SPSS software.

RESULTS

Survey Findings in the Yeşilırmak Basin as Part of the Landscape Atlas Project

For the field research of the Yeşilırmak Basin Landscape Atlas Project, previous studies conducted in the basin were reviewed, including research carried out by the State Planning Organization (SPO) as part of the "Yeşilırmak Basin Development Project." Using the total population data for the provinces and district centers of Samsun, Tokat, Amasya, and Çorum, collectively known as TR83, the number of questionnaires to be administered and the locations for their application were determined using the "Systematic Sampling" method. This method involves selecting samples at regular intervals in proportion to the total population of the main mass (Samsun, Tokat, Amasya, and Çorum provinces and district centers). Consequently, 408 questionnaires were administered based on these calculations.

The surveys were conducted in 34 regions, with clusters of 12 questionnaires each. Clustering into groups of 12 allowed for the surveys to be spread across more regions. Following this method, the provinces and district centers in the basin were listed alphabetically, and the number of regions for each province and district was determined. In cases where a province or district center had more than one region (due to its larger population size), survey locations were selected from different areas on the map.

The implementation process was randomized, and interviews were conducted on a voluntary basis. Efforts were made to ensure a nearly equal distribution of male and female participants. In total, 411 interviews were complet-

ed, exceeding the initial target by three. The fieldwork began in Samsun and proceeded through the provinces of Tokat, Amasya, and Çorum, in that order. Once the fieldwork was completed, the survey data were entered into the SPSS software, where charts were generated to facilitate data analysis.

The information gathered from the survey was crucial in guiding the project team's development of landscape strategies and guidelines. All data obtained from the survey, including insights on locations deemed significant by the local population within the basin based on their way of life, were taken into account in shaping these strategies.

Key Features

When basic statistics such as gender, education, age, marital status and number of children are analysed:

- 51.5% of the respondents are male and 48.5% are female.
- In terms of educational attainment within the Yeşilırmak Basin, 36.8% of respondents were primary school graduates (including both primary and secondary education), 35.1% were high school graduates, 25.6% held university degrees, and 1% had completed a master's or doctorate program. The percentage of respondents who were illiterate or without a diploma was 1.5%.
- The age distribution of the respondents indicates that 28.7% were aged 31-40, 22.4% were 18-25, 15.6% were 41-50, 14.6% were 26-30, 11.9% were 51-60, and 6.8% were aged 60 and above. This distribution shows that the total active population (aged 15-64) represented more than 93% of the respondents.
- When cross-tabulating the responses to the questions on "reasons for leaving the region" and "gender," approximately 50% of respondents indicated a reason for wanting to leave, while the other 50% expressed no desire to leave their place of residence. The most frequently cited reasons for leaving were unemployment (39.7%), cultural limitations (36.2%), and low wages (31.7%). In addition, education (19.1%), unplanned urbanization (16.1%), and other factors (15.6%) were also mentioned as significant reasons for leaving.
- In terms of employment, 29.1% of the interviewees identified their primary occupation as artisans, 23% as wage earners, 14.5% as retirees, approximately 10% as public sector employees, and 2.4% as agricultural workers.

Environmental Problems

In Samsun, the main environmental issues identified were floods (37.3%), unplanned urbanization (34%), noise pollution (33.8%), waste management (28.4%), and global warming (25.6%). In Tokat, the top concerns were unplanned urbanization (14.2%), water pollution (13.7%), waste (13.5%), improper agricultural practices (12.7%), and the extinction of plant and animal species (10.2%). In Amasya, the most significant issues were unplanned ur-

banization (5.6%), water pollution (5.3%), air pollution (4.6%), noise pollution (4.3%), and waste (3.6%). Meanwhile, in Çorum, the primary environmental problems were global warming (12.9%), drought (12.4%), water pollution (11.2%), air pollution (10.4%), and noise pollution (9.6%).

Table 1. *Environmental Problems-Province Comparison*

Environment Problem		City				Total
		Samsun	Tokat	Amasya	Çorum	
Air Pollution	Calculation	87	30	18	41	176
	Percent of total	22.10%	7.60%	4.60%	10.40%	44.70%
Water Pollution	Calculation	95	54	21	44	214
	Percent of total	24.10%	13.70%	5.30%	11.20%	54.30%
Noise Pollution	Calculation	133	37	17	38	225
	Percent of total	33.80%	9.40%	4.30%	9.60%	57.10%
Soil Pollution	Calculation	63	24	12	13	112
	Percent of total	16.00%	6.10%	3.00%	3.30%	28.40%
Waste	Calculation	112	53	14	21	200
	Percent of total	28.40%	13.50%	3.60%	5.30%	50.80%
Erosion	Calculation	35	16	5	10	66
	Percent of total	8.90%	4.10%	1.30%	2.50%	16.80%
Global Warming	Calculation	101	21	9	51	182
	Percent of total	25.60%	5.30%	2.30%	12.90%	46.20%
Drought	Calculation	65	22	8	49	144
		16.50%	5.60%	2.00%	12.40%	36.50%
Flood	Calculation	147	9	5	9	170
	Percent of total	37.30%	2.30%	1.30%	2.30%	43.10%
Destruction of forests	Calculation	79	32	11	23	145
	Percent of total	20.10%	8.10%	2.80%	5.80%	36.80%
Plant animal species	Calculation	81	40	12	32	165
	Percent of total	20.60%	10.20%	3.00%	8.10%	41.90%
Overhunting	Calculation	55	34	7	21	117
	Percent of total	14.00%	8.60%	1.80%	5.30%	29.70%
Wrong farming practices	Calculation	81	50	10	30	171
	Percent of total	20.60%	12.70%	2.50%	7.60%	43.40%
Overgrazing	Calculation	33	21	3	8	65
	Percent of total	8.40%	5.30%	0.80%	2.00%	16.50%

Unplanned urbanisation	Calculation	134	56	22	36	248
	Percent of total	34.00%	14.20%	5.60%	9.10%	62.90%
Adequacy of Water Resources	Calculation	64	43	13	32	152
	Percent of total	16.20%	10.90%	3.30%	8.10%	38.60%
Total	**Calculation**	**197**	**90**	**36**	**71**	**394**
	Percent of Total	**50.00%**	**22.80%**	**9.10%**	**18.00%**	**100,00%**

Definition of the Province of Residence

To gain insight into how residents perceive the cities they live in, they were asked to describe their cities under various categories. The responses aligned closely with field observations. In Samsun, the city was primarily defined as "a green city" (34.3%), "an agricultural city" (32.8%), and "a city suitable for a healthy life" (30.3%). In Tokat, the order shifted, with the city described as "an agricultural city" (19.2%), "a green city" (18.2%), and "a city suitable for a healthy life" (14.6%). In Amasya, participants defined their city as "good for a safe life" (7.3%), "a historical city" (6.1%), and "a green city" (6.1%). In Çorum, 14.4% described it as "good for a safe life," 12.9% as "a historical city," and 12.6% as "an industrial city."

Table 2. Definition of Province of Residence and Provincial Comparison

Desciription of the province of residence		City				Total
		Samsun	Tokat	Amasya	Çorum	
A trade city	Calculation	71	9	5	21	106
	Percent of Total	17.90%	2.30%	1.30%	5.30%	26,80%
A University city	Calculation	112	15	9	23	159
	Percent of Total	28.30%	3.80%	2.30%	5.80%	40,20%
An Industry City	Calculation	62	11	4	50	127
	Percent of Total	15.70%	2.80%	1.00%	12.60%	32,10%
A tourism city	Calculation	43	4	18	13	78
	Percent of Total	10.90%	1.00%	4.50%	3.30%	19,70%
An agricultural city	Calculation	130	76	20	37	263
	Percent of Total	32.80%	19.20%	5.10%	9.30%	66,40%
Science and technology city	Calculation	20	2	3	6	31
	Percent of Total	5.10%	0.50%	0.80%	1.50%	7,80%
Historical city	Calculation	98	43	24	51	216
	Percent of Total	24.70%	10.90%	6.10%	12.90%	54,50%

A green city	Calculation	136	72	24	40	272
	Percent of Total	34.30%	18.20%	6.10%	10.10%	68,70%
For healty living	Calculation	120	58	22	46	246
	Percent of Total	30.30%	14.60%	5.60%	11.60%	62,10%
For safe living	Calculation	117	65	29	57	268
	Percent of Total	29.50%	16.40%	7.30%	14.40%	67,70%
In terms of urbanisation	Calculation	92	9	8	32	141
	Percent of Total	23.20%	2.30%	2.00%	8.10%	35,60%
Culture and Art Activities	Calculation	59	9	10	14	92
	Percent of Total	14.90%	2.30%	2.50%	3.50%	23,20%
Total	Calculation	199	91	35	71	396
	Percent of Total	50.30%	23.00%	8.80%	17.90%	100,00%

Aspects That Have Changed Compared to the Past

The phenomena of migration and increasing environmental pollution are evident in the region, as they are across Türkiye. In response to the question, "What aspects have changed compared to the past?", 85.8% of respondents noted that "Transportation to city or district centers has become easier," 84.6% stated that "The number of people engaged in agriculture has decreased," and 84.4% observed that "Migration to city centers and large cities has increased." Additionally, 83.6% highlighted "a decline in neighborly relations," while 80.9% pointed out that "People are causing more harm to nature."

Table 3. Changes Over Time: A Comparison Across Provinces

Changing Aspects		City				Total
		Samsun	Tokat	Amasya	Çorum	
The Number of People Engaged in Agriculture Has Decreased	Calculation	180	73	31	62	346
	Percent of Total	44.00%	17.80%	7.60%	15.20%	84.60%
Migration to Provincial Centres and Large Cities Increased	Calculation	174	83	30	58	345
	Percent of Total	42.50%	20.30%	7.30%	14.20%	84.40%
Handicrafts have decreased	Calculation	156	66	25	54	301
	Percent of Total	38.10%	16.10%	6.10%	13.20%	73.60%

Increase in Water Pollution	Calculation	133	64	26	48	271
	Percent of Total	32.50%	15.60%	6.40%	11.70%	66.30%
Increase in Air Pollution	Calculation	130	49	23	47	249
	Percent of Total	31.80%	12.00%	5.60%	11.,50%	60.90%
Increase in Soil Pollution	Calculation	114	47	24	32	217
	Percent of Total	27.90%	11.50%	5.90%	7.80%	53.10%
Increase in Income Level	Calculation	74	26	12	26	138
	Percent of Total	18.10%	6.40%	2.90%	6.40%	33.70%
Area in Forests Has Decreased	Calculation	145	47	18	36	246
	Percent of Total	35.50%	11.50%	4.40%	8.80%	60.10%
Interest in uplands Increased	Calculation	128	49	17	36	230
	Percent of Total	31.30%	12.00%	4.20%	8.80%	56.20%
The Number of Poor People Has Increased	Calculation	71	28	13	25	137
	Percent of Total	17.40%	6.80%	3.20%	6.10%	33.50%
Fruit Farming Does Not Provide Income	Calculation	120	60	16	39	235
	Percent of Total	29.30%	14.70%	3.90%	9.50%	57.50%
Livestock Farming Does Not Provide Income	Calculation	124	59	17	36	236
	Percent of Total	30.30%	14.40%	4.20%	8.80%	57.70%
Forests are underutilized	Calculation	140	61	28	41	270
	Percent of Total	34.20%	14.90%	6.80%	10.00%	66.00%
Illegal Forest Cutting Increased	Calculation	79	15	13	21	128
	Percent of Total	19.30%	3.70%	3.20%	5.10%	31.30%
Streams are Polluted	Calculation	118	70	27	47	262
	Percent of Total	28.90%	17.10%	6.60%	11.50%	64.10%
Neighbourhood Relations Weakened	Calculation	176	74	26	66	342
	Percent of Total	43.00%	18.10%	6.40%	16.10%	83.60%
People damages to nature	Calculation	175	72	26	58	331
	Percent of Total	42.80%	17.60%	6.40%	14.20%	80.90%
Historical and Archaeological Structures	Calculation	140	69	22	38	269
	Percent of Total	34.20%	16.90%	5.40%	9.30%	65.80%
Increase in Education Level	Calculation	160	64	23	57	304
	Percent of Total	39.10%	15.60%	5.60%	13.90%	74.30%

Where We Live	Calculation	158	36	21	56	271
	Percent of Total	38.60%	8.80%	5.10%	13.70%	66.30%
Floods and landslides increased	Calculation	116	10	5	7	138
	Percent of Total	28.40%	2.40%	1.20%	1.70%	33.70%
Transportation to the City Centre Has Become Easier	Calculation	187	79	24	61	351
	Percent of Total	45.70%	19.30%	5.90%	14.90%	85.80%
Health Problems Increased	Calculation	151	53	20	61	285
	Percent of Total	36.90%	13.00%	4.90%	14.90%	69.70%
Total	Calculation	207	94	36	72	409
	Percent of Total	50.60%	23.00%	8.80%	17.60%	100.00%

Stakeholder Analysis and Development Strategies in Yeşilırmak Basin Forestry Sector

Ensuring long-term, consistent, and multi-dimensional sustainable planning in forestry activities is essential. In Türkiye, forestry is classified as a sub-sector within the broader agriculture sector according to national development plans. The forestry sector plays a critical role in the protection of natural ecosystems and biodiversity. It is an essential and indispensable sector due to its collective benefits, including erosion control, water regulation, public health, climate regulation, environmental protection, recreation, and tourism (Anonymous, 2012).

Key documents of national and international significance in the forestry sector include the European Union Forestry Strategy, outputs from the United Nations Conference on Environment and Development (UNCED-1992), the Convention on Biological Diversity, the Turkish National Forestry Program, the Forestry Special Expertise Commission Report, the Tenth Development Plan, the National Rural Development Strategy, the National Action Plan for Afforestation and Erosion Control Mobilization (2008-2012), the Sustainable Forest Management Criteria and Indicators 2008 Report, the Forest Ecosystems Monitoring Project, the National Forest Inventory (NFI), and the Forestry General Directorate's Sustainable Forest Management Criteria and Indicator Report, along with the Forest Information System Project (Anonymous, 2012).

In the General Directorate of Forestry's 2013-2017 Strategic Plan, a stakeholder matrix was developed to categorize activities, services, and products within the Turkish forestry sector. Based on this matrix, a stakeholder analysis was conducted at national, regional, and local levels for the forestry sector in the Yeşilırmak Basin (Table 4).

Table 4. *Yeşilırmak Basin Forestry Sector Stakeholders (adapted from Anonymous 2012)- Continued*

1	Parliament	**NATIONAL LEVEL**
2	Ministry of Forestry and Water Affairs	
3	OKA (Central Black Sea Development Agency)	**REGIONAL LEVEL**
4	Yeşilırmak Basin Development Union	
5	XIth Regional Directorate of Forestry and Water Affairs	
6	Regional Directorates of Forestry	
7	DSI Regional Directorate	
8	Governorships (Tokat-Çorum-Samsun-Amasya-Yozgat-Sivas-Erzincan-Ordu-Giresun-Gümüşhane)	**LOCAL LEVEL**
9	Municipalities (Tokat-Çorum-Samsun-Amasya-Yozgat-Sivas-Erzincan-Ordu-Giresun-Gümüşhane)	
10	Special Provincial Administrations (Tokat-Çorum-Samsun-Amasya-Yozgat-Sivas-Erzincan-Ordu-Giresun-Gümüşhane)	**LOCAL LEVEL**
11	Provincial Directorates of Environment and Urbanization (Tokat-Çorum-Samsun-Amasya-Yozgat-Sivas-Erzincan-Ordu-Giresun-Gümüşhane)	
12	Provincial Directorates of Culture and Tourism (Tokat-Çorum-Samsun-Amasya-Yozgat-Sivas-Erzincan-Ordu-Giresun-Gümüşhane)	
13	Provincial Directorates of Food, Agriculture and Livestock (Tokat-Çorum-Samsun-Amasya-Yozgat-Sivas-Erzincan-Ordu-Giresun-Gümüşhane)	
14	Forest Management Directorates (Tokat-Çorum-Samsun-Amasya-Yozgat-Sivas-Erzincan-Ordu-Giresun-Gümüşhane)	
15	Universities (Gaziosmanpaşa University, Hitit University, Amasya University, 19 Mayıs University, Cumhuriyet University, Erzincan University, Giresun University, Ordu University, Gümüşhane University)	
16	NGOs	
17	Private Sector	
18	Local Community /Residents-Forest Villagers-Hunters	

The coordination, monitoring, and supervision of all activities related to the forestry sector in the Yeşilırmak Basin fall under the responsibility of the Ministry of Forestry and Water Affairs, specifically the General Directorate of Forestry, as the highest authority at the national level. At the regional level, the Regional Directorates of Forestry and the XIth Regional Directorate of Forest-

ry and Water Affairs take the lead, while at the local level, forestry enterprises, local communities, and non-governmental organizations form the foundation of the forestry sector's organizational structure.

Forestry strategies in the Yeşilırmak Basin are categorized under four main areas: protection strategies, development strategies, utilization strategies, and institutional capacity-building strategies.

Table 5. *Yeşilırmak Basin Forestry Strategies (adapted from Anonymous 2012) - Continued*

Strategy Number	Strategy Description	Strategy Category
1	Protection of forests against fires	**Conservation**
2	Control and mitigation of forest pests and diseases	
3	Mitigating illegal activities in forests	
4	Protection of forest areas and boundaries	
5	Preservation of biodiversity in forest ecosystems	
6	Enhancing forestry infrastructure capacity	
7	Supporting forest villagers	
8	Increasing forest maintenance and measures	**Development**
9	Rehabilitation of degraded forests	
10	Rejuvenation of forests	
11	Increasing quality and productivity in forest products	
12	Establishment of industrial afforestations	
13	Rejuvenation of forest areas	
14	Meeting the need for seedlings and seeds	
15	Soil Conservation and watershed improvement	
16	Ecosystem-based and multi-objective planning	**Utilization**
17	Production in line with market demand	
18	Reduction of production costs	
19	Orientation towards non-wood forest products	**Institutional Capacity-Building**
20	Transition to certification	
21	Protective and environmental services of forests	
22	Recreation services	
23	Development of human resources	

Stakeholder Analysis and Development Strategies in Yeşilırmak Basin Agriculture Sector

The agricultural sector in Türkiye holds great importance in terms of feeding the population, providing employment, contributing to the economy, and enhancing export potential (Anonymous 2001). At the national level,

stakeholders include the Grand National Assembly of Türkiye, the Ministry of Food, Agriculture and Livestock, the Ministry of Forestry and Water Affairs, the Ministry of Development, and the Ministry of Environment and Urbanization. In addition, strategy documents such as Türkiye 's Tourism Strategy (2023) and Action Plan (2013), the National Climate Change Strategy Document 2010-2020, the Migration Strategy Document, the National Rural Development Strategy, and the National Employment Strategy Document play an important role in the development of the agricultural sector.

Table 6. *Yeşilırmak Basin Agriculture Sector Stakeholders- Continued*

1	PARLIAMENT	**NATIONAL LEVEL**
2	Ministry of Food, Agriculture and Livestock	
3	OKA (Central Blacksea Development Agency)	**REGIONAL LEVEL**
4	Yeşilırmak Basin Development Union	
5	XIth Regional Directorate of Forestry and Water Affairs	
6	Regional Directorates of Forestry	
7	DSİ Regional Directorate	
8	Governorships (**Tokat-Çorum-Samsun-Amasya**-Yozgat-Sivas-Erzincan-Ordu-Giresun-Gümüşhane)	**LOCAL LEVEL**
9	Municipalities (**Tokat-Çorum-Samsun-Amasya**-Yozgat-Sivas-Erzincan-Ordu-Giresun-Gümüşhane)	
10	Special Provincial Administrations (**Tokat-Çorum-Samsun-Amasya**-Yozgat-Sivas- Erzincan-Ordu-Giresun-Gümüşhane)	
11	Provincial Directorates of Food, Agriculture and Livestock (**Tokat-Çorum-Samsun-Amasya**-Yozgat-Sivas- Erzincan-Ordu-Giresun-Gümüşhane)	
12	Provincial Directorates of Culture and Tourism (**Tokat-Çorum-Samsun-Amasya**-Yozgat-Sivas- Erzincan-Ordu-Giresun-Gümüşhane)	
13	Provincial Directorates of Environment and Urbanization (**Tokat-Çorum-Samsun-Amasya**-Yozgat-Sivas- Erzincan-Ordu-Giresun-Gümüşhane).	
14	Forest Management Directorates (**Tokat-Çorum-Samsun-Amasya**-Yozgat-Sivas- Erzincan-Ordu-Giresun-Gümüşhane)	
15	Universities **(Gaziosmanpaşa University, Hitit University, Amasya University, 19 Mayıs University** Cumhuriyet University, Erzincan University, Giresun University, Ordu University, Gümüşhane University)	
16	NGOs	
17	Private Sector	
18	Local Community /Residents- Muhtars-Farmers-Villagers	

Agricultural strategies in the Yeşilırmak Basin are categorized under four main areas: enhancing agricultural productivity, ensuring food safety and security, increasing agricultural income, and promoting sustainable agricultural practices.

Table 7. *Yeşilırmak Basin Agriculture Strategies (adapted from Anonymous 2001 and Anonymous 2013) - Continued*

Strategy Number	**Strategy Description**	Strategy Category
1	Adequate and safe food production and consumption	Enhancing Agricultural Productivity
2	Using breeding material suitable for the region, animal breeding and increasing the amount of cultivated animals	
3	Care and feeding, improving the health and hygienic conditions of shelters	
4	Control of diseases and pests	
5	Improvement of pastures and increasing the production of quality forage	
6	Conscious and quality input use	
7	Opening irrigable areas to irrigation	
8	Improving the use of mechanization and technology	
9	Control of diseases and pests	
10	Soil improvement and land consolidation	
11	Utilization of water resources in aquaculture production	
12	Prevention of pollution of water resources	
13	Production of products with high added value and advantageous for the province	Increasing Agricultural Income
14	Reducing production costs	
15	Improving organization	
16	Development of processing, evaluation and marketing organization	
17	Carrying out national and international implementation and research projects in order to raise the plant and animal health practices of our country to international standards and to ensure the control and eradication of diseases and pests	
Strategy Number	**Strategy Description**	**Strategy Category**
18	Improving control and inspection services,	**Ensuring Food Safety and Security**
19	Production in accordance with quality and standards,	

20	Development of ecological agriculture,	**Promoting Sustainable Agricultural Practices**
21	Prevention of environmental pollution,	
22	Conscious use of natural resources,	
23	No misuse of agricultural land	

Stakeholder Analysis and Development Strategies in Yeşilırmak Basin Tourism Sector

There are many stakeholders in the Yeşilırmak Basin with the potential to develop tourism products and services or to influence tourism development. Successful planning for tourism development can only be achieved through the effective participation of all stakeholders. Rahemtulla and Wellstead (2001) identify the involved parties as participants, regulators, and resource managers, who are responsible for planning, conservation, and management. Drumm and Moore (2002) emphasize the need for the involvement of tourism/ecotourism management staff, representatives of public institutions, experts, scientists, local representatives, tour organizers, as well as non-profit and civil society representatives in the planning process (Yılmaz et al. 2004). According to Carroll (2000), effective stakeholder management involves stakeholder identification, understanding, analysis, and management. Therefore, grouping stakeholders with similar expectations, authorities, duties, and responsibilities helps clarify their potential contributions and expectations. Figure 3 presents the tourism sector stakeholder groups, categorized based on their similar characteristics.

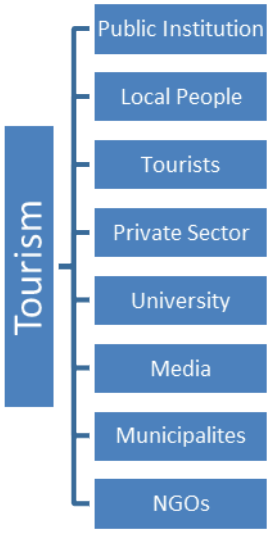

Figure 3. *Stakeholders in the Tourism Sector (based on Drumm and Moore 2005; Demir and Çevirgen 2006; Gültekin 2010; Yenilmez Arpa 2011; Gültekin 2014)*

At the national level, the Grand National Assembly of Türkiye, the Ministry of Culture and Tourism, the Ministry of Forestry and Water Affairs, the Ministry of Development, the Ministry of Environment and Urbanization, and the Ministry of Food, Agriculture and Livestock are the key stakeholders. In addition, strategy documents such as Türkiye 's Tourism Strategy (2023) and Action Plan (2013), the National Climate Change Strategy Document (2010-2020), the Migration Strategy Document, the National Rural Development Strategy, and the National Employment Strategy Document are critical for the development of the tourism sector.

All stakeholders identified as playing a role in the tourism sector development process in the Yeşilırmak Basin are categorized at the regional and local levels, as presented in Table 8.

Table 8. *Yeşilırmak Basin Tourism Sector Stakeholders- Continued*

1	Parliament	**NATIONAL LEVEL**
2	Ministry of Culture and Tourism	
3	OKA (Central Black Sea Development Agency)	**REGIONAL LEVEL**
4	Yeşilırmak Basin Development Union	
5	XIth Regional Directorate of Forestry and Water Affairs	
6	Regional Directorates of Forestry	
7	Governorships (**Tokat-Çorum-Samsun-Amasya**-Yozgat-Sivas- Erzincan-Ordu-Giresun-Gümüşhane)	**LOCAL LEVEL**
8	Municipalities (**Tokat-Çorum-Samsun-Amasya**-Yozgat-Sivas- Erzincan-Ordu-Giresun-Gümüşhane)	
9	Special Provincial Administrations **(Tokat-Çorum-Samsun-Amasya**-Yozgat-Sivas- Erzincan-Ordu-Giresun-Gümüşhane)	
10	Provincial Directorates of Environment and Urbanization (**Tokat-Çorum-Samsun-Amasya**-Yozgat-Sivas- Erzincan-Ordu-Giresun-Gümüşhane)	
11	Provincial Directorates of Culture and Tourism (**Tokat-Çorum-Samsun-Amasya**-Yozgat-Sivas- Erzincan-Ordu-Giresun-Gümüşhane)	
12	Provincial Directorates of Food, Agriculture and Livestock (**Tokat-Çorum-Samsun-Amasya**-Yozgat-Sivas- Erzincan-Ordu-Giresun-Gümüşhane)	
13	Provincial Directorates of Youth and Sports (**Tokat-Çorum-Samsun-Amasya**-Yozgat-Sivas- Erzincan-Ordu-Giresun-Gümüşhane)	

14	Forest Management Directorates (**Tokat-Çorum-Samsun-Amasya**-Yozgat-Sivas- Erzincan-Ordu-Giresun-Gümüşhane)	LOCAL LEVEL
15	Universities (**Gaziosmanpaşa University, Hitit University, Amasya University, 19 Mayıs University,** Cumhuriyet University, Erzincan University, Giresun University Ordu University, Gümüşhane University	
16	NGOs	
17	Local Community /Residents- Muhtars	
18	Private Sector	
19	Media-Press Broadcasting Organizations	

According to Batı (2006), the next step after stakeholder analysis is defined as "stakeholder planning". In this process, plans are made on how stakeholders should be managed and how to ensure the support of stakeholders. For this purpose, the organizational structure created for ecotourism and nature tourism activities in the studies of Yeni et al. (2013) and Gültekin (2014) is proposed for the study area under the title of "Yeşilırmak Basin Tourism Executive and Advisory Board". In this section of the study, the functioning of the board is determined, the duties and responsibilities of tourism stakeholders are defined, and area-specific tourism strategies are developed.

Within the organizational structure specified within the scope of tourism activities in the Yeşilırmak Basin, first of all, monitoring and feedback mechanisms should be actively utilized. Although the management model includes civil society organizations and local people, volunteers are the cornerstones of the functioning of this mechanism. Another problem identified in the area is the insufficient number of civil society organizations and their financial constraints. Provincial Directorates of Culture and Tourism, Forest Management Directorates, Regional Directorate of Forestry and Water Affairs should definitely carry out tourism impact assessment with the support of universities and experts.

It is envisaged that all stakeholders in the organization to be established under the name of "Yeşilırmak Basin Tourism Executive and Advisory Board" will fulfill their duties, and that it will be established with the participation of all stakeholders on a provincial basis under the order of the Governor's Office for monitoring, feedback, consultancy, etc. on issues such as the management and protection of tourism resources, creating resources for the tourism sector, providing relevant trainings, etc. (Yeni et al. 2013, Gültekin 2014). Local people, volunteers and non-governmental organizations are envisaged to take part in the monitoring and feedback unit (Yeni et al. 2013, Gültekin 2014). It is

also envisaged that faculty members who can provide consultancy services on tourism activities in the relevant units of universities located in the Yeşilırmak Basin will provide consultancy services.

The expectations, duties and responsibilities of all tourism stakeholders should be defined in order to carry out planning studies that will enable sustainable conservation and utilization of tourism activities in the Yeşilırmak Basin without causing pressures on nature.

The private sector and public institutions should put aside their conflicts within and between themselves and with each other, and should jointly structure the future of the Yeşilırmak Basin and the local people. Decision makers have very important duties in the tourism planning process. As stated by Tunçer (2005), resources should be allocated for the development of natural and cultural environments. The bureaucratic structure of the Ministry of Environment and Urbanization, the Ministry of Forestry and Water Affairs, the Ministry of Culture and Tourism and other public institutions that are important for the protection of these areas should be improved. In this context, long-term policies based on the country's resources and their priorities should be formulated and put into practice. Based on all the evaluations and literature reviews conducted within the scope of the study, Tourism Sector Development Strategies for the Yeşilırmak Basin were developed (Table 9).

Tourism strategies in the Yeşilırmak Basin are categorized under four main areas: development strategies, marketing strategies, visitor management strategies, and monitoring and feedback mechanisms (Table 9).

Table 9. *Tourism Strategies in Yeşilırmak Basin (Yeni et al., 2007; Gültekin, 2010; Uzun et al., 2011; Yenilmez Arpa, 2011; Gümüş, 2012; 2023 Türkiye Tourism Strategy, 2013; Yeni et al. 2013; Düzce Nature Tourism Master Plan 2013; Gültekin 2014) - Continued*

Strategy Number	Strategy Description	Strategy Category
1	Ensuring the implementation of tourism investment projects, increasing investments in Yeşilırmak Basin	Development
2	Processing tourism products in harmony with the local environment, society and local culture in the development process	
3	Promoting ecotourism as a powerful tool for local development in areas with high potential	
4	Establishing ecotourism special development zones	
5	Carrying out infrastructure works in areas with high potential, developing e-infrastructure works in highlands that are determined to be suitable for tourism, attracting the interest of tourism investors	
6	Increasing revenues by increasing product diversity	

Strategy Number	Strategy Description	Strategy Category
7	Raising awareness on ecotourism (raising awareness of local people and local administrators on ecotourism activities, increasing the recognition of the region by tourists after promotion and marketing activities, etc.)	Development
8	Utilization of incentives and supports for tourism enterprises	
9	Training qualified personnel in the tourism sector within the local community	
10	Organizing existing and new facilities for tourism purposes	
11	Targeting branding on international, country-wide, regional and local scales, starting promotion and marketing activities on the basis of excursion regions in addition to nationwide promotion and marketing	Marketing Marketing
12	Strengthening destination perception in Yeşilırmak Basin, production of a local tourism logo	
13	Certifying tourism companies (especially determining the suitability of companies providing accommodation, food and beverage services for ecotourism activities)	
14	Carrying out an effective promotion and marketing activity with the participation of municipalities, non-governmental organizations, tourism sector and other relevant institutions in order to promote the historical and natural tourism values of the planning area nationally and internationally, increasing the number of tourists and tourism income	
15	Establishment of tourism offices in sub-basins, provincial and district centers to guide visitors	Visitor Management
16	Dissemination of visitor management criteria established by adopting conservation principles	
17	Ensuring maximum visitor satisfaction	
18	Utilization of indicators by monitoring units to monitor the impacts of tourism (monitoring environmental impacts, monitoring the number of tourists visiting the region, determining tourist satisfaction, etc.).	Monitoring and Feedback Mechanisms
19	Measuring the satisfaction of visitors and tourists participating in activities organized in areas with high tourism potential in the Yeşilırmak Basin	

CONCLUSION

As a result of literature reviews, interviews with institutions and organizations, workshops, training meetings, and surveys, it has been found that landscape planning and landscape planning approaches are urgent necessities for the sustainable use of natural resources. It is also essential to determine environmental priorities in sectors such as urbanization, agriculture, forestry, tourism, etc., as such information could not be adequately obtained during the decision-making stage, according to feedback from workshops and field studies. In this context, the content and themes of the landscape atlas have the potential to address this gap both within the Ministry and at the provincial level.

The management adhered to the 'Notification on Principles and Procedures Related to the Establishment, Duties, and Operation of Basin Management Commissions,' which came into effect after being published in the Official Journal, no. 28681, dated 18.06.2013, within the scope of landscape management. Additionally, stakeholder analyses for the forestry, agriculture, and tourism sectors were conducted, and findings were presented under the subheading of landscape management. Furthermore, short, medium, and long-term objectives were established.

Making decisions about location selection, planning, and development in various sectors, as emphasized in the European Landscape Convention (ELC), is crucial because it serves as a tool to consider environmental sensitivity and guide 'Sectoral Plans' at regional, sub-regional, or basin scales.

The Yeşilırmak Basin Landscape Atlas serves as a guide for all public organizations and institutions (e.g., governors, district governors, mayors, muhtars, field service departments, etc.), as well as Non-Governmental Organization (NGO) representatives during spatial planning and decision-making processes at the microbasin level. The atlas was created in an easy-to-understand language and mapping system, making it user-friendly. Moreover, the 'Yeşilırmak Basin Landscape Atlas Project' aims to address significant gaps in spatial and sectoral planning in Türkiye. The project is a crucial tool for integrating environmental, social, and economic plans across different scales with landscape plans.

The successful implementation of the landscape atlas outputs, which were developed through a participatory approach, can be achieved through the ratification of landscape protection, management, and planning laws and regulations by the Turkish Parliament, as outlined in the European Landscape Convention.

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Chapter 7

STRATEGIES AND IMPLEMENTATION METHODS FOR REDUCING CARBON FOOTPRINT IN SUSTAINABLE LANDSCAPE DESIGN

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1. INTRODUCTION

Nowadays, cities suffer from serious environmental problems due to increasing population and industrialisation. Sustainable landscape design projects play an important role in addressing these problems. Integrating sustainability principles into these projects not only provides effective solutions to environmental issues but also offers aesthetic and economic benefits. Sustainability represents a continuous effort aimed at meeting the needs of both present and future generations. Sustainable landscape design combines environmental, social, and economic elements to provide aesthetic and economic advantages. Such designs should minimize energy and resource usage while being compatible with local ecosystems and preserving ecological balance. For successful sustainable landscape design, it is necessary to present solutions that require low maintenance, incorporate soil and water management, support biodiversity, and effectively address environmental issues (Rakhshandehroo et al., 2016; Ghazal, 2019; Meng and Wu, 2024).

The significance of sustainable landscape design is particularly evident in reducing the carbon footprint created by human activities. The carbon footprint refers to the amount of greenhouse gases emitted into the atmosphere as a result of human activities (Çelekli and Zariç, 2023). Disruptions in the carbon cycle increase the likelihood of long-term changes in climate and temperature patterns. This is because carbon-containing gases in the atmosphere have a direct impact on global climate, which has become one of the largest environmental threats on a global scale (Solomon et al., 2009; Çelekli and Zariç, 2023; Bherwani et al., 2024). In particular, the large-scale emissions of CO_2 and other greenhouse gases (GHGs) are triggering a climate crisis worldwide, which stands out as one of the most serious environmental issues (Nunes, 2023). It is known that more than half of the world's population lives in urban areas (World Bank Group, 2023). Therefore, the intense energy consumption and large-scale production activities in urban areas are responsible for the generation of more than half of global CO_2 emissions. These high emissions intensify the urban heat island effect. Additionally, the ongoing climate change significantly affects urban landscape patterns and the carbon cycle (Zhao et al., 2023).

Among the factors influencing the carbon footprint, the materials used in landscape design, plants, and energy consumption hold significant importance. In this context, it is essential to outline a general framework of strategies aimed at reducing the carbon footprint in sustainable landscape design (Nayak et al., 2022; Meng and Wu, 2024; Liu and Zoh, 2024). Various strategies exist, ranging from material selection and energy efficiency to the carbon storage capacity of plant species, maintenance practices, and infrastructure decisions. As an approach aimed at minimizing environmental impacts, sustainable landscape design seeks to mitigate the negative effects of urbanization on nature while also enhancing biodiversity. In this context, the primary goal is to de-

velop strategies for sustainable landscape designs that minimize carbon emissions, efficiently utilize natural resources, and protect the environment in the long term (Green, 2024 a,b).

In this regard, the study aims to contribute to the existing body of knowledge by addressing strategies for reducing the carbon footprint in sustainable landscape design and providing practical solutions for practitioners. By seeking answers to the following questions, the goal is to create a general framework for strategies aimed at reducing the carbon footprint in sustainable landscape designs:

- How can the carbon footprint be reduced through the use of sustainable materials?
- Which materials result in lower carbon emissions compared to others?
- How should plant selections be made to lower the carbon footprint?
- What infrastructures can reduce energy consumption?
- What strategies might be involved in maintenance and management processes within landscape practices that help reduce the carbon footprint?

2. USE OF LOW-CARBON MATERIALS

Landscape architecture plays a critical role in conserving natural resources and combating climate change. In this context, the impact of materials used in landscape projects on carbon emissions cannot be overlooked. The carbon footprint of materials is directly related to the energy consumed during their production, transportation, and installation processes. The production of industrial materials often requires large amounts of energy, most of which is derived from fossil fuels. The energy expended in material production processes typically constitutes a significant portion of carbon emissions. Therefore, in sustainable landscape design, the selection of materials that require less energy during production and minimize environmental impact plays a crucial role (Mfon and Bassey, 2023; Meng and Wu, 2024).

The choice of local materials is an important element of sustainable landscape design, as it ensures less energy consumption and contributes to the conservation of natural resources. It eliminates the need for long-distance transportation, significantly reducing carbon emissions associated with long-haul transport, and provides solutions that are more compatible with local ecosystems. For example, local types of stone and sand blend seamlessly with the environment, creating a more natural appearance (Mohamed et al., 2024). The use of materials obtained from natural and renewable sources, such as natural stone, wood, and bamboo, instead of high carbon footprint materials like concrete and steel, also helps reduce environmental impacts (Arehart et al., 2021).

In addition to natural and renewable materials, the use of recycled materials also holds significant importance in sustainable landscape projects. Recycled materials require less energy compared to the production of new materials and contribute to waste management, thereby helping to reduce the carbon footprint. Utilizing reclaimed or recycled materials such as brick, concrete, ceramics, and wood decreases the demand for new resources (Mfon and Bassey, 2023; Mohamed et al., 2024). Additionally, construction materials such as concrete aggregates, crushed ceramics, and waste granite play an important role in mitigating climate change by trapping and storing atmospheric carbon (Arehart et al., 2021; Mohamed et al., 2024). For example, recycled concrete aggregates exhibit properties similar to natural stone and are produced from recycled materials. The porosity of these materials is higher compared to natural coarse aggregates. Higher porosity allows for greater absorption, significantly reducing carbon emissions. Although lime has a high carbon density during production, it possesses carbon storage potential through air carbonation processes, especially when combined with a low-mileage supply chain. Hempcrete captures carbon through both photosynthesis and carbonation, making it a carbon-storing material. Similarly, bio-based materials such as straw and bamboo are used in sustainable construction projects due to their low concrete emissions and carbon storage potential. Additionally, straw can also be used as biochar to improve soil carbon sequestration. Bamboo can be utilized as both a structural material and a flooring material. New bio-based materials, such as mycelium, also show promise as insulation materials that can reduce the amount of carbon stored in buildings (Arehart et al., 2021). Considering waste materials, more carbon storage by construction materials can be achieved by preventing the demand for virgin raw materials. In this context, recyclable construction waste can be used in urban and garden furniture or flooring. This way, while contributing to landscape sustainability, the amount of waste will also be reduced (Mohamed et al., 2024).

Material selection in landscape projects is critical in terms of reducing carbon emissions and ensuring environmental sustainability. The use of local, natural and recycled materials offers both aesthetic and ecological advantages and constitutes an effective strategy in combating climate change.

3. URBAN GREEN SPACES AND PLANTS AS CARBON SINKS

Cities are identified as crucial actors in mitigating climate change (Behera, 2022). Serving as the driving force for sustainable innovations, cities are leading various strategies aimed at reducing greenhouse gas (GHG) emissions. However, investments in new infrastructure and buildings are contributing to increased GHG emissions. In this context, green planning strategies, practices such as the use of biochar and tree planting, provide stronger contributions

towards mitigating these adverse effects (Ariluoma et al., 2021).

The enhancement of carbon sinks within and around urban areas is proposed as a means to reduce the global GHG impacts of cities (Ariluoma et al., 2021). The sustainability of a city depends on the optimized interactions between its gray infrastructure (e.g., buildings, roads, utilities), blue infrastructure (e.g., lakes, ponds, rivers), and green infrastructure (e.g., urban forests) (Bherwani et al., 2024). In this regard, urban green spaces hold significant potential for carbon sequestration (CSS) and play an important role in directly mitigating climate change (Zhao et al., 2023). In particular, green spaces provide ecosystem services by balancing atmospheric carbon levels through their carbon absorption capacities (Reyes-Riveros et al., 2021).

Nature-based solutions are proposed as effective tools for reducing urban GHG emissions and combating climate change (Zhao et al., 2023). The maintenance and enhancement of trees and other natural carbon sinks are among the primary measures cities can take against climate change (Munoz-Vallés et al., 2013).

Green Infrastructure and Carbon Sequestration

Research on the carbon retention efficiency of urban public green spaces has gained increasing global attention in recent years (Zhao et al., 2023). Findings indicate that green planning can contribute more effectively to climate change mitigation by promoting biochar use and tree planting while ensuring suitable growing conditions (Ariluoma et al., 2021).

Urban green infrastructure encompasses all natural, semi-natural, and artificial ecological system networks in urban and peri-urban areas, including forests, parks, community gardens, private gardens, and street trees (Ariluoma et al., 2021). These public green spaces play a significant ecological role in achieving carbon neutrality by providing natural landscape features in urban areas (Reyes-Riveros et al., 2021). In particular, trees play a vital role in terrestrial carbon sequestration, both as components of forest systems and as individual urban elements (Bherwani et al., 2024).

Terrestrial carbon sequestration is a natural process that involves the storage of CO_2 in soil and vegetation as biomass (Sosulski et al., 2023; Nunes, 2023). The carbon storage capacities of trees, facilitated by photosynthesis, respiration, and decomposition processes, are critical in mitigating climate change in urban areas (Behera et al., 2022). Trees draw carbon dioxide (CO_2) from the atmosphere through photosynthesis and store it in their biomass. This process constitutes the mechanism referred to as carbon sinks (Nowak and Crane, 2002; Nayak et al., 2022).

The biomass of a tree, which increases with its diameter, height, and canopy spread, is proportional to the amount of carbon it stores. The amount of carbon stored in a city increases with tree density and canopy cover. Particularly, large-leaved and long-lived trees have a significant capacity for carbon storage (Bherwani et al., 2024). The strategic placement or use of such trees in urban landscape designs can make significant contributions to reducing the carbon footprint (Nowak and Crane, 2002). The intensive use of plants to retain carbon and reduce carbon emissions will help in achieving carbon neutrality (Zhao et al., 2023) (Figure 1).

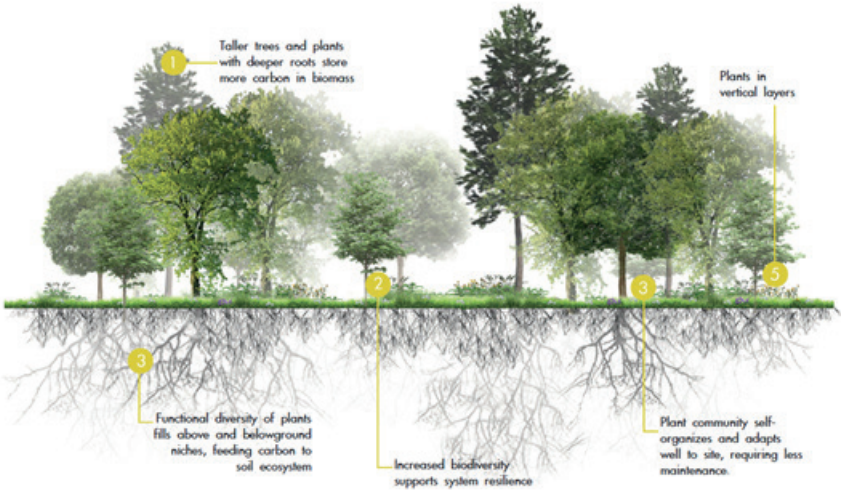

Figure 1. *Woodland Landscapes as Carbon Sequestration (Lynn, 2020)*

The carbon sequestration capacity of urban forests is measured by annual carbon retention rates, which depend on the diversity and age structure of the forest. This situation enhances the role of cities in combating climate change. The increased ability of forests to capture the emitted CO_2 can also improve other ecosystem services, such as water quality and enhanced soil and air conditions (Bherwani et al., 2024). To achieve optimal results in carbon retention and biodiversity conservation, plant species should be strategically selected according to their eco-climatic regions (Behera et al., 2022).

There is a strong relationship between green infrastructure and carbon sequestration. Urban green spaces play a critical role in combating climate change when they are properly planned and managed.

Native Plants, Exotic Species, and Soil Carbon Storage

The preference for native plants in urban landscape designs yields more efficient results compared to the use of exotic species, while enhancing en-

vironmental and ecological sustainability (Behera et al., 2022). Native plants require less maintenance, irrigation, and fertilization because they are adapted to the climate and soil conditions of their regions. This makes native plants have a higher potential for use in carbon retention projects compared to exotic trees. In particular, designs featuring drought-resistant plants with low water requirements provide energy and cost savings while also reducing carbon emissions (Bherwani et al., 2024).

The ecosystem services provided by native plants play a significant role in the conservation of biodiversity, reduction of urban heat island effects, improvement of the hydrological cycle, and carbon retention (Behera et al., 2022). Native plants have the potential to create greater species diversity as they are adapted to the natural conditions of the region. This, in turn, supports the ecological balance by providing habitat and food for local animal species. Additionally, the use of native species offers advantages in terms of causing less damage to the soil and supporting local biodiversity (Özyavuz et al., 2013; Berthon et al., 2021; Bherwani et al., 2024).

In urban carbon storage, not only trees but also soil play a critical role. The soil has significant potential for long-term terrestrial carbon storage (Rodríguez-Albarracín et al., 2023; Sosulski et al., 2023) (Figure 2). According to a study by Churkina et al. (2010), 64% of carbon in urban settlement areas is stored in the soil, while only 20% is in vegetation, 11% in landfills, and 5% in buildings. Therefore, addressing the soil carbon storage capacity is of great importance in the planning and design of urban green spaces (Ariluoma et al., 2021).

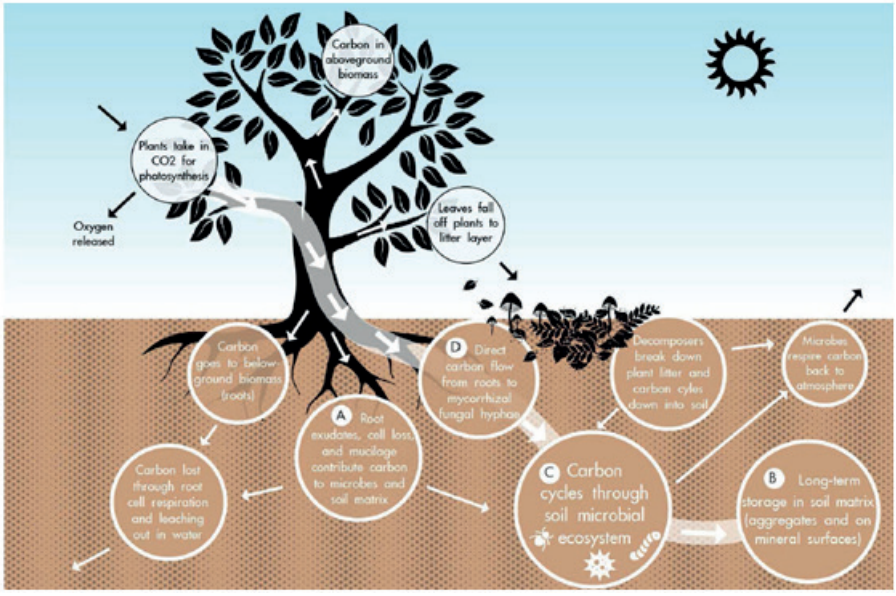

Figure 2. *Key role of plants and soil microbes in long-term carbon storage (Lynn, 2020)*

The use of native plants and soil management are critical components for enhancing carbon storage potential in urban areas. The combined assessment of these two factors can provide effective solutions for combating climate change by increasing the sustainability of urban ecosystems.

4. ENERGY MANAGEMENT IN LANDSCAPE DESIGN PROJECTS

Landscape design is a crucial component of sustainable urbanization, playing a vital role in reducing energy consumption, lowering carbon footprints, and creating solutions compatible with natural ecosystems. Reducing energy consumption and integrating renewable energy sources in landscape design projects are significant strategies for minimizing carbon footprints. Various components consume energy, ranging from water management to lighting. Low-maintenance landscape designs reduce carbon footprints by minimizing energy and water consumption. The use of drought-resistant native plant species eliminates the need for excessive irrigation, maintenance, and chemical fertilization. Furthermore, landscape designs that operate in harmony with natural ecosystems reduce costs due to their minimal intervention requirements. Green spaces that align with natural vegetation also require less irrigation and fertilization (Rao and Gupta, 2020; Esfandi et al., 2024; Liu and Zoh, 2024; Meng and Wu, 2024). These strategies can be made more effective through the selection of drought-resistant plants and designs that are compatible with natural ecosystems.

Renewable Energy Solutions and Energy-Efficient Infrastructures

Renewable energy solutions and energy-efficient infrastructures stand out as effective strategies in landscape designs. Low-energy-consuming lighting systems, smart irrigation technologies, and similar solutions minimize energy consumption, thereby reducing carbon footprints. In landscape designs, utilizing the natural wind direction and speed alongside plant arrangements to create natural shading can reduce the energy consumption of buildings. These types of low-energy infrastructure solutions optimize the interaction between structures and landscapes, minimizing energy use (Wang et al., 2024; Esfandi et al., 2024; Meng and Wu, 2024).

Urban open green spaces play a significant role not only in providing aesthetic and ecosystem services but also in terms of energy efficiency and carbon sequestration. Moreover, ecological design can create spatial patterns along with natural species composition and biomass structure. Natural ecosystems require connectivity for the sustainable flow of energy and materials. However, structures such as roads and buildings disrupt the connectivity of these ecosystems, hindering movement and reducing environmental capacity (Rakhshandehroo et al., 2016). The role of scientific studies is crucial in enhancing

the performance of these designs, which are supported by renewable energy solutions. The design process serves as a tool that combines scientific theory with social practice. Therefore, it is essential to conduct empirical studies to support the performance of planting designs with scientific knowledge to enhance the carbon sequestration potential of local ecosystems. In this way, informed design efforts can provide sustainable solutions against climate change while optimizing both carbon sequestration and other ecosystem services (Ahern, 2013; Wang et al., 2021). The integration of renewable energy sources into landscape projects enables the project to produce its own energy instead of relying on external sources (O'Neil et al., 2022; Meng and Wu, 2024). Renewable energy solutions, such as solar panels and wind turbines, can be utilized in the integration of energy-demanding infrastructures like lighting and water pumps (Kumar J. and Majid, 2020). This allows the landscape to generate its own energy, reducing dependence on external energy sources and operating with zero energy. Innovative solutions that reduce energy consumption to zero are especially employed in large parks and recreational areas. For example, applications such as solar-powered streetlights or water recycling systems have the potential to minimize energy consumption to zero, thus enhancing environmental sustainability (Mohammed et al., 2024). The use of photoluminescent materials that store sunlight and emit light at night also contributes to energy savings in landscape projects while adding an innovative touch to the environment (Garshasbi et al., 2021). Low-energy-consuming lighting systems, smart irrigation technologies, and similar solutions minimize energy consumption, thereby reducing carbon footprints (Chen, 2023).

Water Management

In addition to energy savings, the efficient use of water resources plays a critical role in sustainable landscape practices. The rapid population growth observed in urban areas leads to an increased demand for freshwater resources. Insufficient rainfall and high temperatures exacerbate water shortages and supply issues. This reduction in water resources emphasizes the importance of effective water management (Chen, 2023). Water management is another crucial component for reducing energy consumption in landscape design projects. Various factors such as soil type, root system, plant density, water quality, temperature, humidity, and wind influence the amount and timing of irrigation, making them challenging to determine. In this context, efficient techniques such as smart irrigation systems and drip irrigation are utilized to provide low energy consumption. These systems ensure that water is used only when needed and in appropriate amounts, contributing to both energy and water conservation. Smart sensors further optimize water use by ensuring that water is applied only when necessary. Drip irrigation or subsurface irrigation techniques minimize water loss through evaporation, thereby enhancing energy efficiency. One of the critical issues in design planting is the assumption that

the irrigation regime is always determined by at least drought-resistant species; therefore, a hydro-region should be established to group plants according to their water requirements (Ghazal, 2019).

Water management becomes even more critical in arid regions. In these areas, where climate change increases pressure on water resources, landscape designs utilizing drought-resistant plants are recommended to use water efficiently. This approach, known as xeriscaping, minimizes irrigation requirements, thereby providing both water and energy savings (Zollinger et al., 2006; Sezen et al., 2018; Chen, 2023).

Additionally, the use of organic matter plays an important role in water management by increasing the soil's water retention capacity (Lynn, 2020). It is essential to improve the structural integrity of soils that are weak and have low water retention capacity in landscape practices in arid regions. Soil amendments such as organic matter, compost, and peat significantly enhance the soil's ability to retain water, thereby reducing irrigation needs (Ghazal, 2019; Lynn, 2020). The use of compost represents a practical and effective approach to recycling materials in sustainable landscape practices. Collecting fallen leaves and cut grass can be recycled using organic fertilizers, thereby contributing to nature. The establishment of composting areas contributes to waste management and ensures the return of nutrients that support plant growth back into the soil (Mohammed et al., 2024) (Figure 3). Unlike synthetic fertilizers, compost applications can also prevent the release of potent greenhouse gases like nitrous oxide (Lynn, 2020). The use of mulch is also an effective method for conserving soil moisture. Applying leaves, wood chips, and other organic materials to the soil surface minimizes water loss through evaporation, improves soil structure, and ensures more efficient use of water resources (Ghazal, 2019; Lynn, 2020).

Figure 3. *The composting process (Holmes, 2013)*

Design Proposals

Another strategy to enhance the carbon storage capacity of urban landscapes is the utilization of materials produced by processing wood from felled trees into biochar. Transferring carbon from trees to the soil and converting it into biochar increases the potential for permanent carbon storage. Biochar stores more carbon than mulch applications. Permaculture practices such as hugelkultur also contribute to carbon sequestration by ensuring the long-term retention of organic matter in the soil. The use of wooden materials in buildings and furniture can also extend the duration of carbon storage away from the atmosphere (Lynn, 2020).

Rock gardens are landscape designs that favor drought-resistant and low-water-requiring plant species (Mohammed et al., 2024) (Figure 4). Such plants are commonly used in sustainable landscape designs to promote water conservation. The plant species used in rock gardens are particularly known for their low water needs and resilience to harsh environmental conditions (Abdulrazzaq et al., 2020). Rock gardens play an important role in environmentally friendly landscape designs by contributing to the conservation of water resources while reducing maintenance costs.

Figure 4. *A rock garden design (Abdulrazzaq et al., 2020)*

Green roof and green wall systems enhance energy efficiency and provide ecological benefits in urban areas. These systems significantly reduce the amount of energy buildings require for heating and cooling by providing natural insulation. This energy efficiency can be further reduced when combined with renewable energy solutions such as previously discussed low-energy lighting and smart irrigation systems, leading to a substantial decrease in over-

all energy usage in buildings. Specifically, they help prevent heat loss during winter months and create a natural cooling effect during summer, thereby reducing reliance on energy-intensive systems like air conditioning and heating. Moreover, green roofs and walls not only reduce energy consumption but also contribute to rainwater management, supporting the efficient use of water resources. This aligns with previously mentioned smart irrigation technologies and water-saving landscape practices, positively impacting the urban water cycle (Coulibaly et al., 2023). The rainwater management provided by green roofs reduces water loss through evaporation, facilitating a more sustainable use of water resources. Additionally, green roofs enhance biodiversity within cities and strengthen carbon storage capacity (Catalano et al., 2021; Coulibaly et al., 2023).

Vertical garden systems/green walls also offer important solutions for sustainability and aesthetics in urban areas (Figure 5). Green walls contribute to energy savings for buildings while improving air quality, reducing carbon emissions, and promoting urban biodiversity (Mohammed et al., 2024). In densely populated urban areas, implementing vertical gardens using local species not only adapts to local ecosystems but also contributes to sustainable landscape designs (Rakhshandehroo et al., 2016).

Figure 5. *A vertical garden design (Kırıt and Sağlık, 2018)*

The effect of planting design on carbon sequestration rates is significant. Research indicates that organic-shaped landscape designs absorb more carbon compared to formal designs (Othman et al., 2019; Zhao et al., 2023). In this context, green roof and vertical garden systems emerge as important green infrastructure solutions that enhance carbon sequestration in urban areas. The vegetation used in green roofs reduces carbon footprints by directly storing carbon and decreasing the heating and cooling needs of buildings. Similarly, vertical garden systems increase carbon absorption by expanding the plant surface area, improving the microclimate around buildings, and reducing energy consumption. These systems are essential components of sustainable landscape practices in terms of both energy efficiency and carbon sequestration. Implementing such systems with appropriate planting can mitigate the urban heat island effect and improve air quality (Mohammed et al., 2024). If there is a strong roof structure, various planting designs can be made using small trees, shrubs, and ground cover plants (Rakhshandehroo et al., 2016).

The redevelopment of old urban areas, the transformation of abandoned lands into green spaces, and the conversion of old riverbeds into linear urban parks provide opportunities for expanding urban green spaces (Rakhshandehroo et al., 2016). The permeable surfaces used in these processes nourish groundwater, reduce erosion risk, and help control surface water runoff (Mohammed et al., 2024).

Sustainable landscape designs offer an important solution for achieving ecological balance in the cities of the future by providing energy efficiency and optimizing environmental processes such as carbon sequestration and water management.

5. CONCLUSION

The environmental challenges faced by cities, along with their social and economic impacts, highlight the significance of sustainable landscape design projects. Integrating sustainability principles into these projects not only provides solutions to environmental issues but also contributes to creating more livable cities by offering aesthetic and economic benefits.

Sustainable landscape design plays a critical role in reducing carbon footprints, maintaining ecological balance, and combating climate change. In this context, the crucial importance of urban green spaces in carbon sequestration is supported by plants' ability to fix carbon through photosynthesis and the suitability of local plants to environmental conditions. Particularly, the preference for native plants supports biodiversity while requiring less maintenance and energy, adapting well to environmental conditions. Thus, this approach reduces carbon footprints and contributes to the sustainability of ecosystems.

Material selection is another critical factor in reducing carbon emissions in sustainable landscape design. Choosing low-carbon and recyclable materials minimizes carbon emissions during both production and transportation, thereby enhancing the environmental sustainability of landscape projects. In this regard, the use of recycled materials and the widespread adoption of bio-based construction materials significantly contribute to decarbonization goals.

In addition, the use of compost and low-water-consumption practices contributes to environmental sustainability alongside material selection in sustainable landscape design. For instance, compost promotes organic recycling, while practices such as rock gardens save water, thereby reducing the negative impacts of landscapes on the environment. These practices support more efficient use of natural resources while also minimizing negative effects on the environment.

Moreover, the planning and management of green infrastructure, when integrated with sustainable landscape design, have great potential in reducing carbon footprints and combating climate change in urban areas. Innovative solutions such as green roof and wall systems enhance urban sustainability by strengthening ecosystem services like rainwater management, biodiversity, and energy efficiency.

Developing strategies to reduce carbon footprints in sustainable landscape design will be a crucial step in preserving the quality of life for future generations. Prioritizing this issue in urban planning will increase the capacity to address environmental problems, contributing to the construction of more livable and sustainable cities. Future studies should focus on implementing these strategies with more innovative methods and adapting sustainability principles to various environmental conditions. In particular, promoting the use of local plant species and eco-friendly materials will enhance both the ecological and economic sustainability of landscape projects.

In conclusion, the role of sustainable landscape design in reducing carbon footprints is a significant issue that should be central to cities' strategies for combating climate change. Implementing the necessary strategies to address environmental challenges and preserve the quality of life for future generations is a critical approach. This strategy holds great potential for achieving both ecological balance and enhancing economic sustainability.

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