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Prof. Dr. Sertaç GÜNGÖR

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CONTENTS

CHAPTER 1

MENTAL TRANQUILITY AND SILENCE IN LANDSCAPE ARCHITECTURE: AN EXAMINATION OF SLOW SPACE THEORY

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1. Introduction

Humanity has been in conflict with nature since its inception. In the 21st century, the world faces numerous problems such as noise, unplanned residential development, poverty, and pollution. With the effects of globalization and global warming, cities have emerged as places where many issues are addressed (Aydoğan & Akşit, 2024). These problems have led to the excessive consumption of local values, natural ecosystems, and landscapes in cities (Elovich 2012). This consumption affects users' daily life experiences. In this context, the relationship that 21st-century city dwellers establish with places has been shaped. This relationship has been affected not only physically but also mentally and sensually. Today's cities are governed by speed, productivity, and stimulation. The concepts of speed and noise in urban life significantly reduce individuals' daily experiences and quality of life. In this context, speed and noise keep individuals in a constant state of mental and physical stimulation (Lefebvre, 2013). This state of stimulation is shaped by individuals' senses, and its weakening relationship with the senses has effects such as superficial connections with places and mental fatigue (Honoré, 2009; Roe & Aspinall, 2011). Recent studies in landscape and environmental design emphasize that contemporary urban spaces increasingly prioritize efficiency and rapid consumption, often at the expense of sensory depth and reflective spatial experience, leading to weakened place attachment and diminished perceptual engagement (Düzenli & Yılmaz, 2024). Trying to keep up with the pace of modern life leads to mental problems such as sensory overload and attention deficit. In environments with high levels of environmental stressors and when individuals are unable to connect with nature, they may experience burnout and distractibility (Kaplan & Kaplan, 1989).

The concept of silence does not merely denote freedom from noise; it is also regarded as an area where individuals' mental awareness develops. In this context, the concept of silence both increases internal well-being and emerges as a form of resistance developed against the speed and stimuli of the city (Schafer, 1993). Similarly, the concept of mental tranquillity is a state of mental calm that allows the individual to connect with their surroundings by separating them from the chaos of everyday experiences. Within this framework, silence and slowness emerge as a spatial necessity. The "slow space" approach, born out of this need, emerges as a new way of thinking that aims to transform the relationship individuals establish with time and their surroundings. At this point, the concept of slowness also defines the experience of space within the framework of silence and tranquillity. This concept not only allows movement to slow down but also enables the connection established with space to gain a deeper meaning. Slowness is both a philosophy of life and a design strategy. This is because slowness allows the individual to experience space not linearly but sensually (Honoré, 2009; Lefebvre, 2013).

Slow spaces are areas where time is condensed, opportunities for experience are created, and the groundwork for spatial memory is laid. The quality of time users spend in urban open spaces is directly associated with individuals' physical and psychological well-being. Düzenli, Alpak, and Yılmaz (2019) demonstrate that variations in how different generations use urban open spaces make the temporal dimension of spatial experience more visible. In this context, open spaces that support prolonged stay and experiential interaction respond to users' need to slow down and to establish a more balanced relationship with space. Recent transformations in the use of open and green spaces have highlighted their growing role as environments that support slower, more mindful, and restorative spatial experiences. Düzenli, Yılmaz, and Tarakçı Eren (2021) emphasize that contemporary patterns of open space use increasingly reflect users' needs for calmness, accessibility, and prolonged engagement with outdoor environments. Yılmaz, Düzenli, and Kanlı (2021) emphasize that approaches to urban open spaces have increasingly shifted in response to users' changing expectations regarding everyday rhythms

and spatial experience. The study highlights the importance of conceiving open spaces not merely as areas of movement and circulation, but as environments that allow for pause, mental recovery, and prolonged engagement. In this respect, urban open spaces align with the concept of slow space, supporting calmness, continuity, and human-centered spatial experiences rather than speed-oriented and intensive use patterns.

In the literature, the concept of slow spaces refers to areas that exist outside the dominant pace of life, where individuals possess an awareness of time and their surroundings, can establish rhythmic and sensory connections, and support mental calmness and physical deceleration (Honoré, 2009; Knox, 2005). Another definition describes slow spaces as physical and sensory areas that offer an alternative to individuals' daily pace and stimulation pressures, where the concept of time is experienced more intensely and consciously. These areas are not only places where movement slows down, but also where time slows down and sensory and mental awareness deepen. According to Yavuz and Acar (2016), spatial permeability enhances accessibility, visual continuity, and movement flexibility, allowing users to experience spaces at different paces and through multiple sensory layers. These qualities contribute to the formation of urban environments that support calmness, continuity, and reflective engagement, aligning with the principles of slow and human-centered spatial design. Slow spaces, designed in this vein, elevate the relationship individuals establish with nature to a multi-layered level of awareness. These spaces offer not only physical but also mental organisation through material selection, seating arrangements, plants, shading, and natural interaction. They facilitate a holistic connection with nature (Horé, 2009; Miele, 2013). They strengthen individuals' relationship with nature, enabling mental and emotional healing and thereby increasing their level of well-being (Li et al., 2024). Slow spaces also positively influence feelings of calm and tranquillity through the combined use of visual and auditory elements (Yan et al., 2024). Recent studies on residential and residential environment preferences indicate a growing emphasis on calmness, access to open and green spaces, and the quality of everyday spatial experience. The case of Istanbul demonstrates that users increasingly value residential environments that support slower daily rhythms and psychological comfort, rather than purely functional or high-density urban settings (Yavuz et al., 2025). Additionally, museum open spaces, based on user evaluations, stand out as public spaces that increase the duration of stay and support slower, mindfulness-oriented spatial experiences (Canbakal Ataoğlu et al., 2023). These findings indicate that spatial preferences in contemporary cities are being reshaped not only through considerations of functionality and accessibility, but also through a growing orientation toward spaces that offer potential for slowing down, sensory balance, and mental restoration.

Additionally, by supporting the relationship with one's own body and senses, it enables slowing down through rhythmic transitions, simplicity, and silence (Jorgensen and Keenan, 2012). Thus, an alternative experience of time is offered in landscape architecture through the concepts of silence, slowness, and tranquillity. In this respect, slow spaces are not only aesthetic and relaxing, but also restorative and transformative.

2. Cittaslow Philosophy: Slowing Down Life and Space

The slow space approach is directly linked to the global wave known as the "slow movement". The movement originated in 1986 with the "slow food" movement started by Carlo Petrini in Rome, Italy. Over time, this idea evolved into a philosophy of life that spread beyond food to all areas of life and gained a spatial dimension with the Cittaslow (Slow City) movement that began in the town of Greve in Chianti, Italy. The slow city movement is a community of cities that reject becoming just another cookie-cutter city born of globalisation and instead wish to preserve their local identities and characteristics. Today, more than 250 cities in over 30 countries worldwide are members of this network (Cittaslow International, 2024).

The concept of slow space has developed at the intersection of this movement with landscape, architecture and urban design. In this context, these spaces are not merely "quiet" or "empty" areas, but spaces that alter users' perception of time, foster a sense of closeness to nature, and support mental restoration processes (Roe & Aspinall, 2011). This approach, which views space as not only physical but also experiential, is also linked to Henri Lefebvre's theory of "rhythmology" (Lefebvre, 2013). Lefebvre argues that the "mechanical rhythms" of modern life are in conflict with the "organic rhythms" that individuals establish with nature. This contradiction leads to a weakening of the individual's relationship with space and produces alienation. Slow spaces can be summarised as "rhythmic spaces" that align with individuals' natural rhythms and provide space for changes in their daily lives.

Cittaslow has established "slow principles" in the context of architecture, transport and environmental sustainability with the aim of improving the quality of life in small-scale towns (Miele, 2013). The Cittaslow movement offers a vision of social transformation that prioritises quality of life over speed-oriented urbanisation. The movement's principles shape not only administrative strategies but also the sensory, rhythmic and experiential dimensions of space. These principles are outlined below.

2.1. Prioritising Quality of Life Over Speed

Today, urban life is generally shaped around speed. The Cittaslow movement draws attention to the detrimental effects of speed on individuals' physical and mental health. The concept of speed not only causes movement to slow down, but also leads to a reduction in consumption, attention spans and communication. Slow spaces, on the other hand, enable individuals to engage in more thoughtful and sensory interactions with their surroundings (Honoré, 2009). These spaces, which find architectural expression in concepts such as silence and mindfulness, slow down the pace of life while also giving meaning to time. The primary goal of this philosophy is to improve the quality of life for city users. Research confirms these results. In recent years, there has been a noticeable increase in the quality of life in cities that are part of the Cittaslow network.

For example, after becoming a member of Cittaslow, the town of Lidzbark Warmiński in Poland implemented projects by local authorities that improved residents' needs and enhanced the quality of life for the community (Brodziński & Kurowska, 2021). Similarly, positive effects on urban life have been observed in the slow city initiatives implemented in Seferihisar, Turkey's first Cittaslow town (Ciğerci and Turan, 2023).

In landscape architecture, pedestrian-focused and human-scale spaces are created to support this principle when designing slow spaces. Squares, green spaces and recreational areas are designed to reduce noise and traffic sounds, increasing opportunities for people to relax, socialise and interact with nature. As a result, the Cittaslow philosophy's principle of quality of life improves the daily experiences of city users by creating healthier and more liveable spaces in urban design.

2.2. Preservation of Local Identity and Culture

The principle of preserving local identity and culture is one of the core principles of the Cittaslow movement. In response to the standardisation brought about by globalisation, slow cities place importance on preserving their unique history and cultural heritage. Established in 1999, the Cittaslow network is an association of cities that aims to create a way of life that preserves local identity (Ciğerci and Turan, 2023). This philosophy means resisting uniformity by preserving and sustaining the historical fabric and traditional heritage of the city. As emphasised in the literature, the Cittaslow concept highlights the importance of locality as a

solution to the problem of loss of identity arising from fast-paced living, without losing the values that form the spirit of a city (Orhan, 2017).

The principle of preserving local identity and culture in landscape architecture is demonstrated through design decisions that are appropriate to the local fabric and culture. Parks and gardens that utilise local plant species, urban furniture that reflects the city's cultural motifs, and materials used in accordance with the urban fabric are designs that align with the principles of slow space design aimed at preserving local identity and culture. Thus, this principle prevents the standardisation of urban spaces, allowing each city to develop its own unique landscapes. The connection individuals form with spaces is also strengthened through structures that carry cultural continuity and historical memory (Knox, 2005). Miele (2013) argues that slow spaces are areas of spatial memory.

2.3. Sustainable Environmental Policies

Cittaslow promotes a city life in harmony with nature to ensure environmental sustainability. One of the fundamental principles of being a slow city is not polluting the environment and ensuring sustainability. In this context, these cities implement various policies to preserve ecological balance and leave a liveable environment for future generations. The use of renewable energy, the promotion of recycling, and the reduction of waste are fundamental criteria (Orhan, 2017). These cities also have goals such as environmentally friendly infrastructure and improving air quality. Slow cities are sustainable.

In the discipline of landscape architecture, this principle is applied through the integration of green infrastructure and nature-sensitive design strategies. Strategies such as rainwater harvesting, permeable surfaces, natural corridors, solar-powered lighting, and the use of materials that reduce the carbon footprint contribute to environmental sustainability. The increase in city parks also ensures the protection of biodiversity and resilience against the climate crisis, which is the biggest problem facing the world today. Ultimately, Cittaslow's principle of sustainability ensures the creation of more liveable environments by requiring the protection of nature and the preservation of ecological balance in urban design decisions.

2.4. Supporting Local Production

The principle of supporting local production is one of the key principles reflecting Cittaslow's sustainability dimension. This principle encourages the protection of small producers as opposed to consumption habits. It ensures the creation of markets that can be accessed directly by the public by promoting the consumption of products produced using organic and traditional methods. This both revitalises the local economy and ensures that products that can be considered part of the city's heritage are carried into the future. The discipline of landscape architecture creates meeting places between producers and consumers through slow space design. For example, the markets established in Seferihisar have created spaces where local producers can showcase their products, while also establishing landscape areas that facilitate social interaction (Orhan, 2017).

Another fundamental principle of the Cittaslow movement, the preservation of local identity, is a strong resistance against the cultural uniformity caused by rapid urbanisation processes. Slow cities aim to preserve traditional values at every stage, from architecture to landscape design, and pass them on to future generations in order to retain their uniqueness. This approach aims not only to create physical environments in cities but also to integrate social values into the space. Slow spaces, which blend traditional architecture with modern design concepts, ensure that cultural continuity is passed on to future generations. In this context, design criteria such

as the use of local stone and wood products and the promotion of natural species are embodied. In this context, for visitors to the city, unique experiences such as strolling through streets shaped by local architecture and sampling flavours unique to the region also enhance the city's value (Nilsson et al., 2011).

2.5. Community Spirit

The principle representing the social dimension of the Cittaslow movement is the principle of community spirit. This principle promotes solidarity and social relations among individuals living in the city. It aims to revive neighbourly relations, which have been lost due to rapid urbanisation, through slow spatial designs.

The principle of community spirit refers to the bonds individuals form with a place and the people who share that place. Oldenburg's (1999) concept of the "third place" emphasises the importance of public spaces such as cafés, parks and squares, which enable social encounters and everyday communication, for the social cohesion of a city. Cittaslow has turned this perspective into a spatial planning principle, aiming to increase the number of spaces in urban design that are conducive to the formation of a sense of community, open to initiatives, and encourage social interaction (Miele, 2013). Within the discipline of landscape architecture, this principle aims to create not only individual relaxation areas but also shared spaces where collective experiences can take place.

2.6. Human-Centred Use of Technology

The Cittaslow movement advocates that technology should be used in a more human-centred way rather than being completely excluded. In the face of urbanisation and digitalised lifestyles, technological solutions that enable individuals to have meaningful experiences in spaces are encouraged. With this understanding, the principle of quality rather than quantity is emphasised in the use of technology (Miele, 2013).

The concept of "slow technology" was defined by Hallnäs & Redström (2001) as technologies that enable individuals to interact with time, create space for reflection, and raise awareness through their design. This approach advocates for systems that are quietly noticed, learned, interactive, yet non-intrusive, rather than distracting screens and intense information flows.

Consequently, these spaces are not a refuge for individuals under pressure from speed and consumption, but rather a proposal for a mental life practice. With this understanding, the aim is to introduce a design language based on sensory balance, mental integrity, and social sustainability to the discipline of landscape architecture.

The Cittaslow movement is not merely a model of city management, but a holistic philosophy of life in which the concept of "slowness" is present at every stage of design. This philosophy, particularly in the discipline of landscape architecture, ensures that cities are not only functional but also more liveable in sensory, cultural, and social contexts (Miele, 2013). In this context, each principle should be considered together with its spatial counterpart. The principles and their spatial counterparts are shown in the table below.

Principle Design equivalent in space	Principle Design equivalent in space
1. Prioritising quality of life over speed	Benches that allow you to sit still, shaded rest areas, walking paths
2. Preservation of local identity and culture	Use of local materials (stone, wood), use of regional plant species, harmony between traditional architecture and modern design
3. Sustainable environmental policies	Permeable surfaces, rain gardens, shade-providing natural vegetation, water cycles compatible with the local ecosystem, and energy-efficient landscaping elements.
4. Preservation of local identity and support for production	Handmade seating elements, collaboration with local artisans,
5. Strengthening community spirit	Collective seating areas, sharing-focused spatial design
6. Human-centred use of technology	Informative yet unobtrusive digital displays, audio applications introducing nature sounds, etc.

Table 1. Determining the principles of Cittaslow and their counterpart in slow space design

Spaces shaped by slow design theories aim to preserve local identity, enhance quality of life, ensure sustainability, and enrich users' spatial experiences. In this context, these principles not only provide a framework for the design approach but also offer a concrete response. Following the slow city movement, public spaces influenced by this movement offer users an alternative time experience outside the pace of everyday life. Concepts such as silence and tranquillity are fundamental components of these spaces. Slow spaces designed within cultural and ecological contexts in different geographies provide an opportunity to see the reflection of these principles in practice (Mayer & Knox, 2006).

The examples of slow spaces from around the world presented below illustrate areas shaped by these principles.

3. Examples of International Spaces Designed According to the Principles of Slowness

Due to the speed-oriented structure of contemporary urban life, individuals' relationship with space has become superficial. In this context, slow spaces offer users a spatial experience removed from the concept of speed. Areas designed in accordance with slow city principles are shaped by principles such as silence, integration with nature, spatial awareness, and alternative time experiences (Mayer & Knox, 2006). Below are examples of slow space applications that stand out in the discipline of landscape architecture.

3.1. Rain-Hearing Pavilion – Hefei, China Assessment

The Rain-Hearing Pavilion is a small-scale project located within the campus grounds of Hefei, China. Covering an area of approximately 137 m², this pavilion and its surroundings focus on a traditional village element – the water well – as the centrepiece of its design (URL 1).

Figure 1. **Rain-Hearing Pavilion – Hefei, Çin (URL 1)**

The Rain-Hearing Pavilion is an example of a slow space that emphasises auditory awareness and encourages interaction with nature. Its design, which allows the sound of rain to be heard, enables users to experience mental tranquillity. It allows for silence and sensory calm in urban environments dominated by noise pollution. When evaluated in terms of slow space principles, it supports users' focus on their senses by allowing them to stay in the space for long periods, in line with the principle of "prioritising quality of life over speed". It has been observed that listening to the sound of rain increases participants' visual attention in the space and creates positive feelings. The Rain Hearing Pavilion's design similarly emphasises the sound of rain, providing visitors with tranquillity and a positive experience. (Sun and Dong, 2022) The aesthetic experience created by the sound of raindrops directs users towards nature without technological intervention. The use of natural materials contributes to the concept of

sustainability. It contributes to a broader movement aimed at increasing urban sustainability and promoting mental health in increasingly chaotic environments. By prioritising sensory experiences and strengthening the connection with nature, such spaces can serve as a vital balancing element against the fast-paced lifestyle that dominates modern cities. This is in line with the principles of the Slow City (Cittaslow) movement, which advocates for the preservation of local characteristics and the improvement of quality of life through conscious urban planning and community participation. In this context, the Rain-Hearing Pavilion demonstrates that integrating natural elements into urban design can create tranquil environments that not only reduce noise pollution but also enrich the urban fabric by encouraging social interaction and community cohesion. (Belli and Çelik, 2022).

3.2. Gulbenkian Garden - Lisbon, Portugal Assessment

Gulbenkian Park is located in the city of Lisbon, Portugal. Established in 1969, it is part of a cultural centre that houses the headquarters of the Calouste Gulbenkian Foundation. The park, which covers 19 acres, features a large lake and a smaller pond (URL 2).

Gulbenkian Garden offers visitors a sense of "urban forest" within the city, promising natural tranquillity. Wide walking paths, vegetation and seasonal changes create a visual aesthetic that provides visitors with rich visual, olfactory and tactile experiences. As people wander around the space, they escape the intense pace of the city and relax in nature, contributing to their quality of life. This design creates an environment that draws people in with their senses, offering a calming, enjoyable experience throughout the day.

The garden also preserves Portugal's modern landscape architecture heritage, keeping the local identity alive. Originally created in the 1960s by Portuguese designers such as Gonçalo Ribeiro Telles and Antonio Viana Barreto, the original garden is a place with which the people of Lisbon have formed an emotional bond. While making new arrangements, respect was shown for the historical heritage of the area, and continuity was ensured between the old and new sections. The expanded new design reflects the natural forms and local materials of traditional Portuguese gardens. Careful attention has been paid to the use of local materials and craftsmanship in the garden, ensuring both cultural and economic sustainability. Gulbenkian Park has also successfully integrated sustainability principles into its landscape design. With its renewed design in 2024, the space has been conceived with the aim of creating an ecological system (URL 2). Careful attention has been paid to the use of local materials and craftsmanship in the space, striving to achieve cultural and economic sustainability. With these characteristics, the space is not merely a place of relaxation but also a living space that is sustainable and preserves local identity. Furthermore, the integration of sustainable practices in urban parks such as Gulbenkian supports the preservation of local identity while striving to improve the ecological footprint. This situation also serves as a model for different cities. It is an important element in the context of the Cittaslow movement, which advocates slow cities that prioritise quality of life and local character over rapid urbanisation (Topal et al., 2016).

Figure 1. **Gulbenkian Garden - Lizbon, Portekiz (URL 2)**

This park promotes community participation and supports the use of native flora and fauna, ensuring that parks become vital areas for ecological education and social interaction, and demonstrating the fact that urban green spaces are indispensable for sustainable city life (Subaşı and Ferah, 2024). This situation is consistent with the principles of the Slow City (Cittaslow) movement, which advocates for the preservation of local characteristics and the improvement of quality of life through community participation.

4. Conclusion

The concept of slow space emerges as a way of life that transforms an individual's perception of time, nature, and society. Shaped by principles such as the preservation of local identities, environmental sustainability, and community interaction, this approach offers an alternative living experience to the fast-paced urban lifestyle. In this context, the two parks examined, Rain-Hearing Pavilion (Hefei) and Gulbenkian Garden (Lisbon), are two examples that bring the slow space theory to life through different design strategies. Inspired by China's traditional garden culture, the Rain-Hearing Pavilion integrates sound into its design, emphasising the therapeutic effect of natural soundscapes on mental health. (Sun et al., 2022); (Kang & Schulte-Fortkamp, 2016), while the Gulbenkian Garden creates a tranquil public space with its local flora and sustainable design. (Oliveira et al., 2025). Both spaces offer users not only the opportunity to rest and relax, but also the chance to experience a state of being and the moment in a slow-paced environment.

In conclusion, slow spaces are a holistic design approach that promotes not only mental tranquillity at an individual level, but also social solidarity, the visibility of local values, and ecological awareness. This approach should be evaluated not only at the aesthetic or functional level in landscape architecture, but also as an ethical stance and philosophy of life (Honoré, 2004; Gehl, 2011). Slow spaces, which serve as a "pause area" against the noise, chaos, and speed of the city, are landscape design concepts that establish the relationship between humans and nature and form the basis of healthy cities.

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CHAPTER 2

DROUGHT-TOLERANT LANDSCAPE APPROACHES: PLANNING AND UTILIZATION OF DROUGHT-RESISTANT PLANT SPECIES

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1. INTRODUCTION

Global climate change, rising temperatures, and dwindling freshwater resources are among the main challenges threatening environmental sustainability worldwide. Especially in rapidly urbanizing regions, the sustainable management of green spaces is just as important as their preservation and development. In this context, the discipline of landscape architecture has undertaken the responsibility of producing not only aesthetic but also ecological and functional solutions (Demirkan et al., 2025).

Although awareness of water conservation has increased in recent years, high amounts of water are still consumed, particularly in irrigating green areas. This situation necessitates the development of new approaches in landscape design that prioritize water efficiency. In this context, the "xeriscape" approach stands out as an environmentally friendly design philosophy that promotes the efficient and sustainable use of water. Drought-tolerant landscaping is a landscape model created using plant species that have low water requirements, resulting in low maintenance costs and positive environmental impacts. This approach not only saves water; it also supports biodiversity, reduces the urban heat island effect, and creates an environment compatible with local ecosystems (Seyhan and Bayramoğlu, 2020). In countries located in the Mediterranean climate zone, such as Turkey, there are many native plant species that are naturally adapted to drought, and integrating these species into landscape design has great potential in terms of both ecological and cultural sustainability (Kavuran and Yılmaz, 2022).

The aim of this study is to outline the fundamental principles of the drought-tolerant landscape approach, to examine the morphological and physiological characteristics of drought-resistant plant species, and to evaluate their role in landscape design through examples from Turkey. Thus, the aim is to create a scientific basis for sustainable landscape strategies that will contribute to the conservation of water resources.

Across Türkiye, particularly in the Central Anatolia, Southeastern Anatolia, Aegean, and Mediterranean regions, areas are identified as having a high risk of drought (Figure 1).

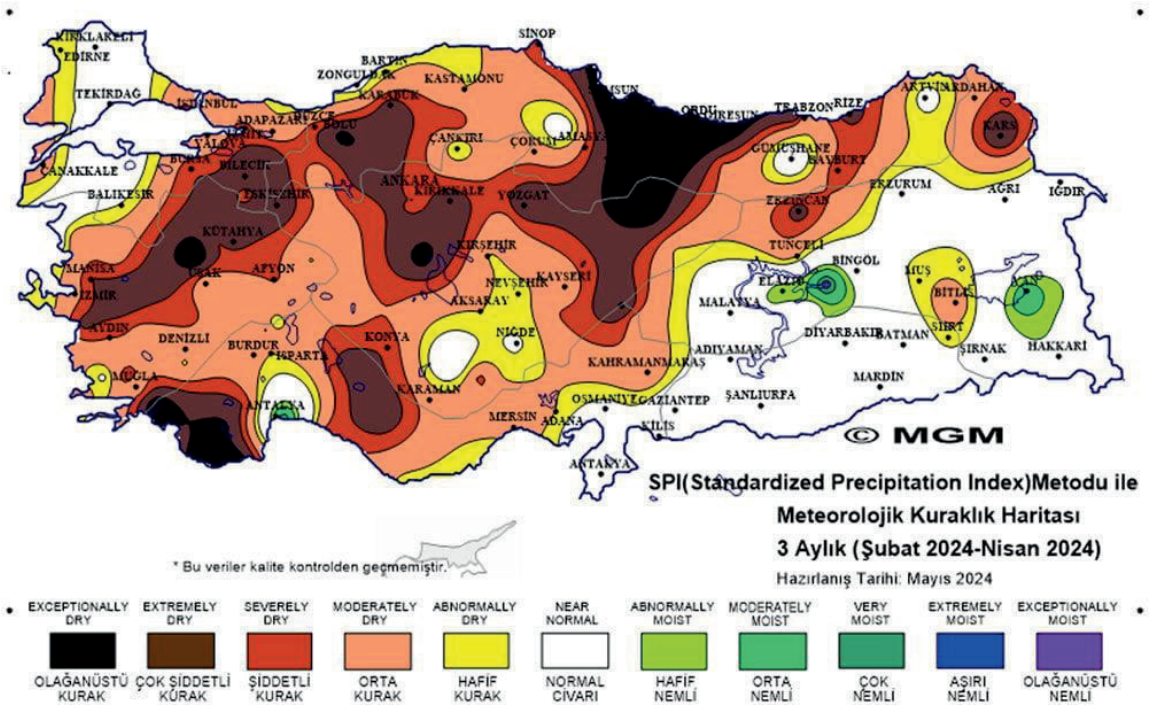

Figure 1. High-risk drought regions in Turkey (Ministry of Environment, Urbanization and Climate Change)

2. FINDINGS

2.1 Plant Characteristics

Key characteristics of drought-tolerant plants include deep root systems, small and hairy leaves, a thick cuticle layer, and physiological adaptations such as CAM photosynthesis (a carbon fixation pathway found in some photosynthetic plants). These features minimize water loss, enabling plants to survive in drought conditions (Taiz et al., 2018).

Drought-tolerant plants are plant species with special adaptations that allow them to adjust to extreme environmental conditions. The fundamental morphological and physiological characteristics of these species enable them to survive in habitats where water is limited. One of the most notable adaptations is their deep and extensive root system. These roots extend to the lower layers of the soil profile, facilitating access to groundwater resources and enabling the plant to maintain its water supply during drought periods (Örs & Ekinci 2015).

Leaf morphology also plays an important role in xerophytic plants. Small, narrow, and often hairy leaves minimize water loss through transpiration by reducing surface area. The hairs on the leaf surface help retain moisture while also reflecting sunlight, preventing overheating. These structures regulate the plant's microclimate and maintain water balance (Acharya, 2021).

Another critical feature is the thick cuticle layer. The cuticle is a waxy structure that covers the surface of leaves and stems, preventing water evaporation and increasing the plant's water retention capacity. This layer also acts as a physical barrier against pathogens.

At the physiological level, xerophytic plants exhibit specific metabolic pathways such as CAM (Crassulacean Acid Metabolism) photosynthesis. CAM photosynthesis is based on the principle that stomata open at night to take in carbon dioxide and store this gas in the form of organic acids. Because

the stomata remain closed throughout the day, water loss is kept to a minimum. This mechanism saves water while maintaining photosynthetic efficiency, especially in hot and arid climates (Geydan & Melgarejo, 2005).

When all these adaptations are combined, drought-tolerant plants stand out as plant species that are resistant to water stress, highly energy-efficient, and ecologically sustainable. These characteristics make these plants a preferred choice in landscape design and the restoration of arid areas.

2.2 Types Available for Use in Turkey

The species that stood out in the research are as follows:

- *Lavandula spp.* (Lavender): Aromatic, purple-flowered, low water requirement
- *Rosmarinus officinalis* (Rosemary): Perennial, ground cover, drought-tolerant plant
- *Juniperus horizontalis* (Spreading juniper): Erosion control and visual impact
- *Thymus spp.* (Thyme): Native, aromatic, and supports biodiversity (Table 1).

2.3 Design Strategies

- • **Hydrozoning:** Dividing plants into zones according to their water needs (Figure 2).
- • **Grass Alternatives:** Converting lawn areas with drought-tolerant ground cover species
- • **Use of mulch and permeable soil:** Reduces evaporation and retains water
- • **Rain gardens:** Systems that support the natural water cycle (ASLA, 2020; St. Hilaire et al., 2008; WUCOLS, 2014; Davis, 2008).

Plant Species	**Morphological Characteristics**	**Physiological Characteristics**	**Area of Use in Landscaping**
Lavandula spp.	Small, hairy leaves	Low water requirements	Median strips, aromatic gardens
Rosmarinus officinalis	Woody trunk, dense foliage	CAM photosynthesis	Ground cover, thematic areas
Juniperus horizontalis	Spreading form, coniferous	Deep root system	Erosion control, boundary line
Thymus spp.	Miniature leaves, aromatic	Slow metabolism	Grass alternative, bee-friendly area.

Table 1. Characteristics of Drought-Tolerant Plant Species

Figure 2. A landscape plan showing a hydrozoning application (AI was used to create the image)

3. Plant Species Cards

Plant species selected within the scope of drought-tolerant landscape design hold an important place in sustainable environmental design due to their ecological adaptability and low maintenance requirements. It presents the characteristics and visual placement of selected plant species for drought-tolerant landscape design (Figure 3). From both aesthetic and functional perspectives, drought-tolerant plants have versatile uses in landscape design. Examples like lavender (*Lavandula angustifolia*), rosemary (*Rosmarinus officinalis*), spreading juniper (*Juniperus horizontalis*) varieties provide spatial richness with their variety of color, texture, and scent. These species are often preferred in theme gardens, along walkways, for erosion control on slopes, or in low-maintenance green spaces. In this way, a sustainable and climate-sensitive landscape concept is created, ensuring both visual aesthetics and the efficient use of water resources.

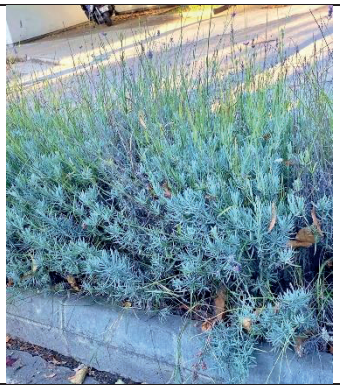	
Lavandula angustifolia	Lavender
Area of Use:	It can be used as a border plant, in rock gardens, or in large clumps.
	
Rosmarinus officinalis	Rosemary
Area of Use:	It can be used as ground cover or in shaped borders.
	
Juniperus horizontalis	Spreading Juniper
Area of Use:	This accent plant has a wide range of uses as a windbreak or ground cover.

Figure 3. Some plant species and their characteristics used in drought-tolerant landscaping.

4. Water Consumption Comparison

This study comparatively analyzes the monthly water consumption levels of traditional lawn areas and drought-tolerant plant areas. Presented in bar graph format, the data reveals the water use profiles of both landscape approaches throughout the year, quantitatively demonstrating the water-saving potential of drought-tolerant plants. The graph highlights not only the absolute consumption values but also the percentage savings achieved compared to traditional practices, supporting the crucial role of plant selection in resource management within sustainable landscape design. In this context, the

study aims to contribute to basing strategic decisions on scientific principles in order to increase water efficiency in landscape planning (Ünal Çilek, 2023; Hudak, 2005) (Table 2).

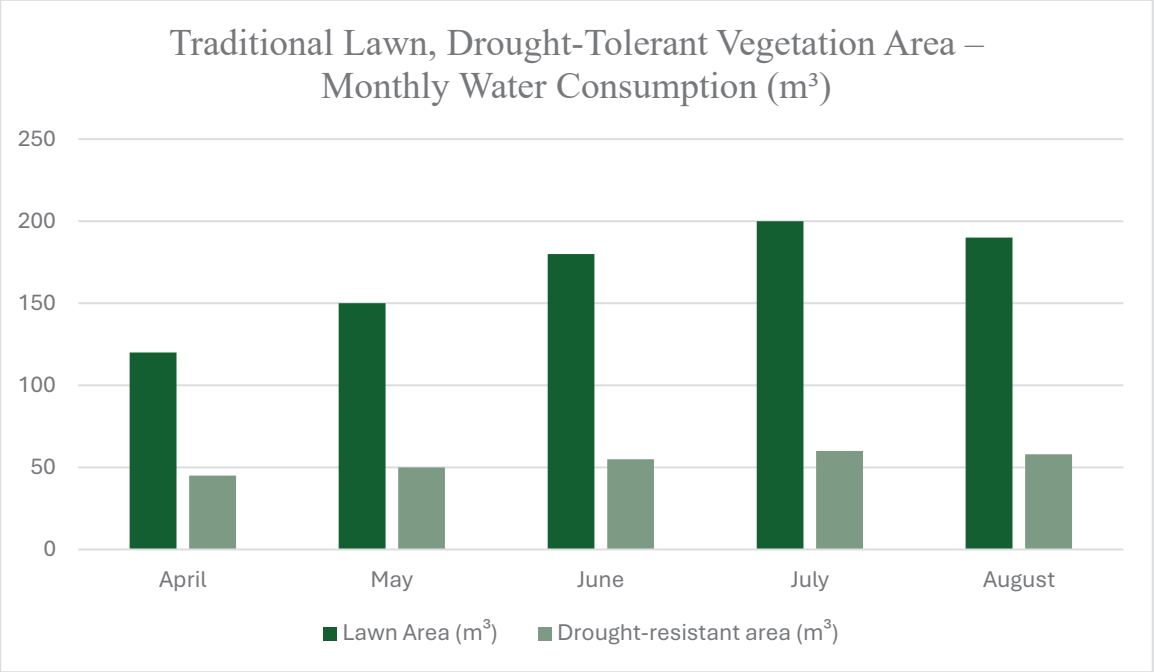

Table 2. Water Consumption Comparison (Huang, B., X. Liu, and Q. Xu., 2001)

5. Application Area Map

This map aims to visually present examples of cities in Türkiye where drought-tolerant landscape practices have been successfully implemented. Cities like Izmir, Tekirdağ, Antalya, and Mersin, located in different climate zones, are home to pioneering practices that increase water efficiency through the use of drought-tolerant plants and embrace sustainable landscape design. The markings on the map highlight regional diversity and scale of application, demonstrating that drought-tolerant landscaping is not limited to hot and arid regions, but can be effectively applied in diverse geographical conditions (Figure 4). This image serves as a reference for local governments and designers in developing climate-friendly landscape strategies.

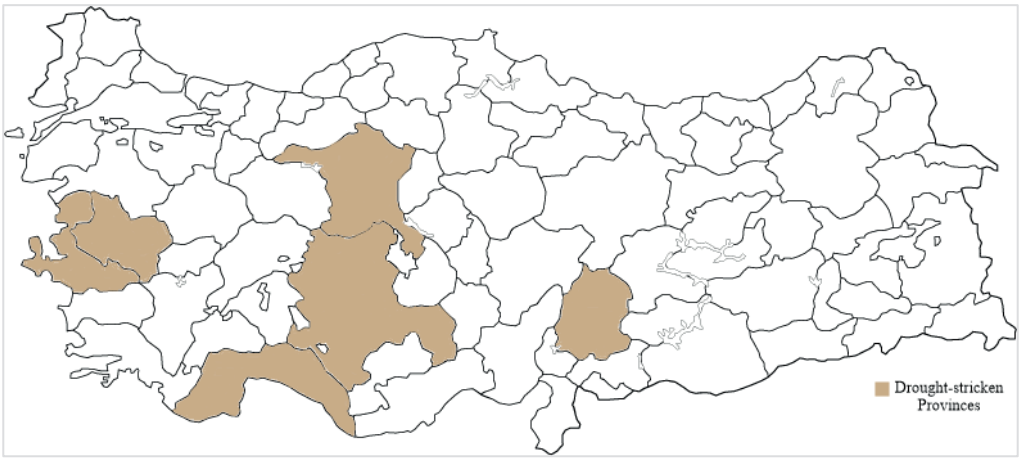

Figure 4. Provinces in Turkey where successful drought-tolerant landscape practices have been implemented.

Xeriscaping practices are concentrated in water-stressed regions that generally experience hot and dry summers (Table 3).

Featured Cities	Application Type	Types of Plants Used
İzmir, Manisa	Extensive urban parks, municipal projects, industrial areas (e.g., ESBAŞ).	• *Lavandula angustifolia* • *Rosmarinus officinalis* • *Pistacia lentiscus* • *Phlomis fruticosa* • *Olea europaea*
Antalya	Water-saving landscaping and park renovations in areas with tourism and dense urbanization.	• *Bougainvillea glabra* • *Agave americana* • *Nerium oleander* • *Washingtonia filifera* • *Lantana camara*
Kahramanmaraş	Large urban parks and recreational areas in inland regions where the risk of drought is increased.	• *Juniperus spp.* • *Berberis thunbergii* • *Cotoneaster horizontalis* • *Salvia officinalis* • *Euphorbia spp.*
Ankara, Konya	In large cities where water resources are under pressure, water efficiency is increasingly being promoted, particularly in municipal landscaping projects.	• *Tamarix spp.* • *Artemisia spp.* • *Sedum spp.* • *Spartium junceum* • *Cistus spp.*

Table 3. Provinces where drought-tolerant landscaping practices are implemented, their application methods, and the plants used (Abacioglu Gitmis, 2020; Çorbacı et al., 2011; Water Efficiency Campaign, 2024; Mutlu, 2017).

Plant species used in drought-tolerant landscape design stand out not only for their aesthetic value but also for their low water consumption, ecological contributions, and ease of maintenance. The species listed below serve as examples of sustainable landscape practices in this context.

Lavender (*Lavandula angustifolia*) is an aromatic plant that is perfectly suited to arid areas with its low water requirements and need for full sun. Due to its low maintenance requirements, it is widely used in road dividers and aromatic gardens. It also offers an important food source for pollinator organisms thanks to its bee-friendly composition (Garbuzov & Ratnieks, 2014)).

Rosemary (*Rosmarinus officinalis*) is an evergreen species that requires moderate care and prefers sunny locations. It is commonly used in thematic landscaping and as ground cover. Thanks to its deep root structure, it contributes to erosion control and supports soil stability (Pamay, 1992).

Spreading juniper (*Juniperus horizontalis*) is preferred in areas such as borders and rock gardens due to its very low water requirements and tolerance to shade. This species, which stands out with its very low maintenance requirements, reduces the risk of erosion thanks to its soil-retaining properties, while also creating habitats for small organisms (Var, 2010).

Thyme (*Thymus vulgaris*) is an aromatic, native species that could be considered as an alternative to grass. This plant, which prefers full sun and requires low maintenance, supports biodiversity by being friendly to bees and butterflies. Its capacity to form natural vegetation in arid areas makes it valuable both functionally and ecologically (Pamay, 1992).

A common characteristic of these species is their adaptation to arid conditions with low water and maintenance requirements. At the same time, each of them offers contributions that enhance the ecological functionality of the landscape: such as pollinator support, soil conservation, habitat provision, and year-round greenery. Therefore, drought-tolerant landscape design is a strategic choice not only in terms of visual appeal but also in terms of environmental sustainability (Table 4).

Plant Species	**Water Requirement**	**Sun Desire**	**Maintenance Level**	**Area of Use**	**Ecological Contribution**
Lavandula angustifolia	Low	Full sun	Low	Aromatic gardens, road dividers	Bee-friendly, pollinator-supporting.
Rosmarinus officinalis	Low	Full sun	Medium	Thematic areas, ground cover plants.	Erosion control, year-round green.
Juniperus horizontalis	Very Low	Sun / shade	Very Low	Boundary line, stone gardens	Soil retainer, habitat provider
Thymus vulgaris	Low	Full sun	Low	Grass alternative, aromatic areas	Bee and butterfly friendly, native species.

Table 4. Plant Species Suitable for Drought-Tolerant Landscaping – Characteristics Table

6. CONCLUSION AND RECOMMENDATIONS

This study has shown that drought-tolerant landscape design is a strategic tool in combating climate change and in the sustainable management of water resources. The morphological and physiological characteristics of drought-resistant plant species, the selection of native species compatible with the Turkish flora, and design strategies that increase water efficiency present a new paradigm in landscape architecture.

The recommendations developed based on the research findings demonstrate that drought-tolerant landscape practices are not only a technical solution but also a tool for social, cultural, and environmental transformation. First and foremost, it is critical that local authorities develop planning guidelines that promote drought-resilient landscaping practices. These guidelines should be supported by standardizing and widely disseminating documents such as the Ministry of Agriculture and Forestry's "Drought-Resilient Landscape Implementation Guide" to practitioners (Kavuran and Yılmaz, 2022). This will ensure consistency between practices in different regions and develop solutions tailored to local conditions.

In terms of education and awareness, drought-tolerant landscape training programs should be organized for landscape architecture students, municipal employees, and the public. These programs should not be limited to the transfer of theoretical knowledge; interactive learning environments should be created through aromatic gardens and thematic areas where the public can directly experience the concepts. This approach will contribute to the spread of a sustainable living culture by raising public awareness about water conservation and ecological adaptation. Prioritizing the use of drought-resistant species native to Türkiye's flora (such as *Thymus vulgaris* and *Juniperus horizontalis*) will both strengthen ecological compatibility and reduce maintenance costs. Choosing native species will also contribute to the conservation of biodiversity and the preservation of cultural landscape identity. This approach also offers a more economically sustainable model by reducing

dependence on imported species. Research and monitoring processes are crucial for assessing the long-term impacts of drought-tolerant landscape practices. Universities and research institutions should regularly monitor indicators such as water consumption, soil health, and biodiversity, and share the data obtained. This database will ensure that future applications are based on scientific principles and will provide guidance for policymakers. Finally, a balance between aesthetics and functionality should be considered in drought-tolerant landscape designs. Drought-resistant practices should be considered not only a technical necessity but also an aesthetic asset. Visual quality can be enhanced through variety in color, texture, and form, thereby strengthening the emotional connection users have with space (T.C. Ministry of Agriculture and Forestry, 2024). This balance will facilitate the adoption of drought-tolerant landscapes by society and ensure the long-term acceptance of sustainable designs.

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CHAPTER 3

EVALUATION OF MEMORY SPACES FROM THE PERSPECTIVE OF LANDSCAPE ARCHITECTURE

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1. Introduction

Memory is formed through the process of an individual's socialization (Halbwachs, 1992). Halbwachs conceptualizes social memory as the shared social frameworks within which individual recollections are constructed. Pierre Nora, who regards space as an instrument of social memory, argues that memory derives its source from the "group" and acknowledges its collective, plural, and individualized nature (Nora, 2006). According to Assmann (2015), the accumulation of events such as changes and developments occurring in different geographies and societies shaped by diverse cultures and ways of life, as well as wars, natural disasters, and migration, contributes to the formation of the past (Demirarslan, 2018).

In his work Les Lieux de Mémoire (Realms of Memory), Nora brings together the concepts of collective memory and memory places. According to Nora, memory is life itself, produced by living groups. His primary focus, however, is not memory per se but rather memory places. Memory places emerge from the notion that spontaneous memory no longer exists. In this sense, memory places are not what we remember, but rather the sites where memory is generated and cultivated. Memory emerges within these places, and symbols associated with memory are also formed there. Nora further provides a more specific definition of memory places, describing them as "any significant entity, whether material or immaterial, that has become a symbolic element of the shared memory of a community through human will or the passage of time" (Nora, 2006). Accordingly, memory places extend beyond tangible and visible objects alone.

2. Memory Places

Within the discipline of architecture, the concept of memory is evaluated through the relationship established between the individual and space. Memory production occurs as a result of the sensory responses individuals develop toward the physical characteristics of space, such as scale, texture, form, and color. In addition to individual reactions, memory is socially shaped through social, political, architectural, and cultural events of a particular period, as well as traditions and rituals (Aydın Öksüz et al., 2018). Halbwachs (1992) emphasizes the relationship between memory and space by stating that the only place where individuals living in a society can situate their memories and retrieve them when desired is "social memory," and that remembering therefore requires either a past or a space filled with traces of memory (Urry, 2002). This highlights the fundamental role of memory in the formation of space.

Nora's notion of "togetherness" explains the semantic dimension of individual memory places. Beyond this semantic aspect, memory places themselves often exist "together" as a result of a conscious effort to resist forgetting. People first translate their knowledge and memories into words; subsequently, the commemorative value and function of remembrance become literary in nature (Haliloğlu, 2004). At this stage, elements that constitute cultural memory—such as traditions, customs, language, and ways of life—are transferred to spaces that extend beyond the human scale. In terms of their existence and reality effects, memory places resolve the uncertainties embedded in both memories and nations, as well as the complex relationships arising from them, in a rapid and decisive manner. While these places are sites where memory is cultivated, they also serve as sources of tradition. For this reason, memory places possess a distinct social character, displaying and emphasizing ethnic diversity and subcomponents of identity. Memory places may take the form of monuments that consciously evoke remembrance and/or contemporary cultural landscapes such as streets. They are modest yet assertive, traditional yet simultaneously contemporary. Memory places contain remnants and constitute an extreme form in which commemorative consciousness persists throughout history. In this sense, they can be interpreted as a constant movement between space and memory (Nora, 2006).

Societies produce specific spatial arrangements in order to remember events, values, and individuals from their past. These spaces may sometimes be monuments, cemeteries, or everyday public spaces embedded within the urban fabric. Examining memory places within the context of landscape requires not only an analysis of the physical environment but also an evaluation of symbolic, cultural, and psychological layers. In modern theory, landscape is regarded not merely as a natural surface but as a cultural palimpsest that carries human experiences and historical continuity (Corner, 1999). For this reason, memory places constitute an important tool for concretizing meaning in space by utilizing the multilayered structure of landscape.

3. The Relationship Between Memory Places and Landscape Architecture

Landscape is a complex concept situated at the intersection of geography, history, architecture, landscape architecture, anthropology, and cultural studies. On the one hand, it is an organic structure shaped by natural processes; on the other, it is a cultural surface bearing the traces of human activity. Consequently, landscape functions as a multilayered representational field encompassing historical continuity, cultural change, and processes of social memory production.

This characteristic renders landscape an indispensable instrument for understanding memory places. Landscape is not merely the backdrop of memory; it is its very carrier. Therefore, the ability to read landscape has become one of the fundamental methods for deciphering collective memory. Landscape sometimes bears witness to wars, disasters, and destruction, and at other times serves as the spatial обол of rituals, traditions, and cultural continuities. From this perspective, examining memory places through the lens of landscape entails not only physical analysis but also an in-depth interpretation of historical, sociological, and cultural realms of meaning.

The relationship societies establish with their past is not limited to historical documents, written narratives, or oral traditions. Human communities largely remember the past through space, interpret it through space, and attempt to transmit it to the future through space. For this reason, examining the bond between memory and space requires not only a historical effort but also a sociological, cultural, psychological, and spatial analytical process. At the center of these investigations, the concept of “memory places” constitutes one of the cornerstones of modern memory studies and has gained increasing importance in landscape-oriented research since the late twentieth century. A memory place is not only an abstract concept but also a concrete design problem. For a space to be recognized as a memory place, its social meaning, historical context, and symbolic burdens are as significant as its physical characteristics. Thus, memory places require a multidimensional analysis. Moreover, the purpose of memory places is not solely to commemorate the past. These spaces are also part of contemporary politics, identity debates, ideological orientations, and cultural negotiations. Memory constructed through space is a process in which social structures are continuously reproduced. Memory is not a frozen trace embedded in space, but a dynamic phenomenon that is constantly reinterpreted and interacts with the spirit of time. In this context, landscape functions as a surface upon which memory politics can be read.

This role of landscape becomes even more visible through the design of memory places. Today, modern landscape architecture assumes significant responsibilities in the design of memory places. Elements such as the emotions evoked in users, the organization of experiential sequences, the symbolic meanings of plant textures, and the interpretation of topography all constitute integral parts of the design process. Therefore, examining memory places from a landscape perspective requires a comprehensive evaluation of design practices as well.

One of the primary contributions this study aims to present is the recognition that addressing memory places from a landscape perspective remains an underexplored area within the literature. While memory studies are generally examined within the axes of history and sociology, studies addressing how this concept is handled within the field of landscape architecture are limited. In the context of

Turkey, this body of literature is even more restricted. Consequently, examining memory places through landscape not only enables the reading of the spatial traces of the past but also facilitates an understanding of how social memory is produced, the transformative effect of space on identity, and the spatial reflections of memory politics. In line with this comprehensive approach, this study aims to offer an extensive evaluation encompassing both international literature and the Turkish context, thereby deeply interrogating the relationship between memory places and landscape.

In order to examine memory places from a landscape perspective, it is first necessary to comprehensively articulate the theoretical traditions upon which these places are founded. In modern social sciences, memory is addressed as an interdisciplinary concept evaluated at the intersection of sociology, anthropology, history, psychology, geography, architecture, and cultural studies. Similarly, the concept of landscape carries plural meanings, encompassing both natural and cultural layers, changing throughout historical processes, and being imbued with social meanings. Therefore, understanding memory places requires a holistic interpretation of theoretical frameworks that explain how memory is produced, transmitted, and related to space.

4. Theories of Collective Memory

▪ Maurice Halbwachs and the Concept of Collective Memory

One of the foundational figures in modern memory studies is Maurice Halbwachs. Rather than defining memory as an individual mental process, Halbwachs conceptualizes it as a collective phenomenon shaped by society (Halbwachs, 1992). According to him, individuals do not remember in isolation; they remember through the discourses, values, norms, and spatial contexts of specific social groups. One of Halbwachs's most significant contributions is his systematic articulation of the relationship between memory and space. Memory, in his view, is shaped together with the physical environment; space provides the framework for the act of remembering. In other words, memory is inherently spatial.

▪ Jan Assmann and Cultural Memory

Assmann (2015) divides memory into two categories: *communicative memory* and *cultural memory*.

- **Communicative memory** refers to forms of oral memory transmitted across approximately three generations.
- **Cultural memory**, by contrast, is an institutionalized, long-term form of memory constructed through rituals, symbols, texts, monuments, and spaces.

This distinction is particularly important from a landscape perspective, as memory places are often the materialized and spatial manifestations of cultural memory. Assmann's approach reinforces the idea that memory exists not only in the human mind but also within the material world.

• Paul Ricoeur and the Dialectic of Memory–History–Forgetting

Ricoeur introduces an ethical and philosophical dimension to memory studies. He argues that remembering is always selective, incomplete, and interpretive, and that history itself is neither fixed nor entirely objective. Within this framework, memory places can be understood as ideological constructs that reflect how societies choose to perceive their past. Ricoeur's perspective is especially valuable for understanding the political nature of memorial landscapes.

▪ Connerton and Rituals of Social Remembering

Paul Connerton (2012) argues that memory is transmitted through rituals, bodily practices, and social habits. This perspective emphasizes that memory places are not merely physical entities but also performance spaces. Ceremonies held in public squares, commemorative marches, and practices of visitation represent the spatial manifestations of this approach.

- **Pierre Nora and the *Lieux de Mémoire* Approach**

Pierre Nora argues that in modern societies, traditional forms of memory have weakened, and memory is no longer sustained naturally but rather through specific places and symbols. He refers to these as *lieux de mémoire*, or memory places (Nora, 2006).

According to Nora, memory places possess three fundamental dimensions:

1. **Material dimension:** monuments, cemeteries, museums, squares.
2. **Symbolic dimension:** meanings attributed to space, rituals, ceremonies.
3. **Functional dimension:** their role as carriers of memory within society.

These three dimensions explain why memory places are particularly significant in the context of landscape, as landscape can embody material, symbolic, and functional values simultaneously.

Nora further notes that with modernization, collective memory has been detached from everyday living environments and relocated into objectified spaces. This transformation has led to the proliferation of monuments, national parks, battlefields, and museum landscapes. This process represents a critical moment for landscape architecture, as public spaces have become not merely areas of circulation and recreation, but stages for national and social memory.

5. Types of Memory Places

Nora categorizes memory places into three main groups:

- Archives: spaces where written and visual memory is stored.
- Museums: spaces in which collective memory is displayed and curated.
- Monuments, squares, and ceremonial spaces: areas where memory is symbolically reproduced and re-enacted.

This classification corresponds closely with the specific components of landscape and provides a foundational framework for understanding the spatial character of memory places. When the theoretical integrity of the memory–space–landscape relationship is examined, three fundamental conclusions emerge:

1. Memory is a social phenomenon and is constructed through space.
2. Space functions as both the carrier and the producer of memory.
3. Landscape constitutes the most comprehensive spatial context, encompassing both the natural and cultural layers of memory.

Therefore, examining memory places from a landscape perspective necessitates the simultaneous consideration of both the material and symbolic dimensions of memory.

6. The Relationship Between Space and Memory and Landscape Approaches

The relationship between memory and space plays a central role in the formation of social identity, the maintenance of cultural continuity, and the interpretation of the past. As articulated by Halbwachs (1950), memory should not be understood as an individual phenomenon but as a collective structure shaped within social frameworks. This perspective reinforces the idea that memory is constructed on a spatial plane, positioning space as both the medium and the context of remembering.

- **The Role of Space in Remembering**

The role of space in processes of remembering constitutes one of the core debates in memory studies. While Halbwachs (1950) emphasizes that memory is reproduced through social frameworks, he also underlines that space is one of the most fundamental components of these frameworks. Human communities inhabit specific spaces and attribute meanings to them; therefore, the act of

remembering cannot be separated from space. A battlefield, a village square, an old school building, or a temple functions as a material carrier of memory.

According to Ricoeur (2004), memory is closely related to traces inscribed in space. These traces may be physical (such as a monument), symbolic (such as rituals), or emotional (such as a topography associated with fear or mourning). Consequently, space is not merely the background of remembering but constitutes remembering itself.

Connerton (1989), on the other hand, explains the impact of space on memory through rituals and bodily practices. He argues that communities often transmit the past through repetitive rituals performed in specific places. Commemorative ceremonies, marches, and collective visits are largely tied to particular spaces. Thus, space becomes a domain in which remembering is institutionalized. When these approaches are considered together, the following conclusion emerges: space functions simultaneously as the framework, the material, and the means of production of memory

- **The Role of Landscape as a Carrier of Memory**

Landscape occupies a unique position within memory studies because it encompasses both natural and cultural layers. Owing to this characteristic, landscape constitutes the most extensive spatial form capable of materializing the multilayered structure of memory.

Schama (1995) defines landscape as “a deeply inscribed cultural text of memory.” Landscape bears the traces of human experiences throughout history; agricultural fields, remnants of warfare, ritual spaces, sacred mountains, and industrial ruins represent the spatial manifestations of these traces. Landscape functions simultaneously as a silent witness to human history and as an active narrator of it. Cosgrove (1984) argues that landscape is also an ideology; according to him, landscape is the product of a particular culture’s way of seeing the world. In this sense, memory landscapes also operate as visual and spatial representations of cultural identity. For instance, national parks, republican squares, or sacred sites are spatial expressions of how a society chooses to perceive and represent itself.

Jackson (1984) emphasizes that landscape contains historical stratification; to understand landscape is to read the past. This perspective offers a strong theoretical framework for explaining how memory places are shaped through landscape.

- **Social Practices of Remembering and Landscape**

Social memory is sustained not only through symbols and myths but also through practices. The spaces in which these practices take place enable memory landscapes to integrate with everyday social life

- **Rituals and Ceremonies**

As noted by Connerton (1989), rituals constitute one of the most powerful instruments of collective memory. Many of these rituals take place at the landscape scale: commemorative ceremonies at Anıtkabir, ritual walks at the Gallipoli Martyrs’ Memorials, and the annual moments of silence at the Hiroshima Peace Memorial Park. These examples demonstrate that landscape is directly intertwined with practices of social remembering.

- **Topography and Emotional Impact**

Landscape is not merely a visual surface; it is also an experiential field that evokes emotions. Tuan (1977) explains the emotional dimension of space through the concept of topophilia, which refers to the aesthetic, cultural, and emotional bonds that people form with places. Trauma landscapes—such as battlefields, disaster zones, and mass grave sites—make the emotional relationship between people and place particularly visible. Foote (2003) suggests that such spaces can be interpreted as “tragic landscapes” that carry deep imprints of social memory.

- **Silence and Void**

Memory landscapes are often designed to evoke feelings of silence, emptiness, uncanniness, or calmness. This aesthetic approach is especially evident in modern memorial landscapes. Eisenman's Berlin Holocaust Memorial (2005) and the large water voids of the 9/11 Memorial (Arad & Walker, 2011) exemplify this design strategy.

- **Healing Through Landscape**

Walker and Sørensen (2010) argue that healing landscapes connect processes of mourning with spatial experience. For this reason, elements such as water features, open spaces, rhythmic walking paths, and zones of silence are frequently employed in memory landscapes.

Summary of Literature Findings

1. Based on the literature review, the following conclusions can be drawn:
2. Memory is a social phenomenon constructed through space (Halbwachs, 1950).
3. Space functions as both the physical and symbolic carrier of memory (Ricoeur, 2004).
4. Memory is sustained in space through rituals and practices (Connerton, 1989).
5. Landscape represents the most layered spatial form of memory (Schama, 1995; Cosgrove, 1984).
6. Memory landscapes are imbued with meanings related to identity, ideology, and politics (Nora, 1989).

7. Principles for the Creation of Memory Spaces in Landscape Design

Memory spaces, as spatial representations of collective memory, encompass not only historical events but also emotions, identity, political values, and shared experiences. Therefore, when approached from the perspective of landscape design, they are understood as multilayered and meaning-laden environments that extend beyond mere physical forms. Contemporary memory landscapes have moved away from the traditional notion of vertical monuments and have instead adopted more participatory, experiential, and sensory design approaches (Young, 1993). This section systematically examines the principles governing the creation of memory spaces within the landscape context, in line with theoretical frameworks, international examples, and the core principles of landscape architecture.

• Establishing Spatial Meaning

The most fundamental component of memory landscapes is the production of meaning. Nora (1989) emphasizes that sites of memory are defined by their "density of meaning." Accordingly, the initial step in design is to determine the nature of the memory to be represented, its spatial translation, and its symbolic structure.

- **Symbolic Layer**

In landscape design, symbols serve as the primary carriers of memory. A void, a water element, a pathway, or even a single tree can generate powerful meanings. For example, the voids at the 9/11 Memorial symbolize loss (Arad & Walker, 2011).

- **Layered Meanings**

Schama (1995) argues that landscapes contain historical layers. Therefore, preserving traces of past layers, textures, and morphological characteristics is essential in design. Approaches based on "cleansing" or complete reconstruction risk erasing memory.

- **Design of Sensory Experience**

As noted by Tuan (1977), the relationship established with space is not solely visual but multisensory. Memory landscapes should incorporate environmental components that affect users emotionally, physically, and cognitively.

- **Visual Composition**

Visual axes, perspectival sequences, and focal points function as powerful narrative tools in memorial landscapes. For example, the gradually unfolding perspective along the Lion Road at Anıtkabir creates a deliberately choreographed ritual experience (Bozdoğan, 2001).

• Auditory Atmosphere

Auditory elements such as the sound of water, wind, and silence enhance sensory depth in memory spaces. At Hiroshima Peace Memorial Park, silence and the sound of water define the emotional tone of the site (Hoskins, 2013).

• Touch and Bodily Experience

Auditory elements such as the sound of water, wind, and silence enhance sensory depth in memory spaces. At Hiroshima Peace Memorial Park, silence and the sound of water define the emotional tone of the site (Hoskins, 2013).

• Touch and Bodily Experience

Connerton (1989) emphasizes that memory is transmitted through bodily practices. Accordingly, pathways, climbing areas, slowed walking routes, and ground textures activate bodily memory.

• Ceremonial Spaces

Gathering areas, ceremonial plazas, and procession axes constitute the core components of collective memory rituals. For example, commemorative walks organized at the Çanakkale Martyrs' Memorials are integrated with the ritual function of the landscape (Winter, 1995).

• Practices of Leaving Traces

Some memory landscapes allow users to leave symbolic traces within the space, such as mourning notes, areas for placing flowers, throwing stones into water, or lighting candles. These micro-rituals strengthen the personal dimension of memory (Walker & Sørensen, 2010).

8. Ecological and Cultural Sustainability

Memory landscapes should be evaluated not only in aesthetic and symbolic terms but also in relation to ecological and cultural sustainability.

• Preservation of the Ecological Context

UNESCO (2023) emphasizes that maintaining ecological integrity in cultural landscapes is essential for the preservation of memory. For instance, battlefield landscapes often encompass extensive natural habitats. The transmission of intangible cultural heritage involves processes such as rituals, traditional practices, local toponyms, and narratives (Assmann, 2011).

9. Management of Visitor Experience in Memory Spaces

The success of memory spaces is closely related to how effectively the visitor's spatial and emotional experience is guided.

• Wayfinding and Flow Design

Axes, entry points, transitions, and the gradual unfolding of spaces create a ritualized experience. Anıtkabir represents a classical example in this regard (Bozdoğan, 2001).

• Informational Panels and Digital Technologies

Young (1993) argues that excessive explanation can render memory spaces overly didactic; therefore, informational panels should be used in moderation. Today, augmented reality applications further enrich the memory experience.

• Security, Respect, and Ethical Considerations

Visitor behavior is particularly sensitive in sites associated with trauma. In memorials such as those at Srebrenica and Rwanda, “zones of silence” are regarded as an ethical necessity (Foote, 2003).

Conclusion; In conclusion, three main outcomes stand out in the design of memory landscapes:

1. The production of spatial meaning constitutes the foundation of design; symbols, voids, and layers shape this meaning.
2. Visitor experience is the most critical criterion of memory spaces; sensory design, rituals, and bodily practices mediate this experience.
3. Sustainability must be addressed in both ecological and cultural dimensions to ensure the long-term survival of memory.

These principles demonstrate that memory landscapes are not merely aesthetic objects but integral components of processes of social meaning-making.

10. Constructing Memory Spaces in Landscape Architecture Education

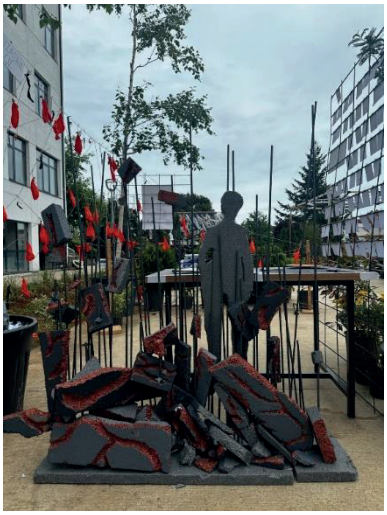
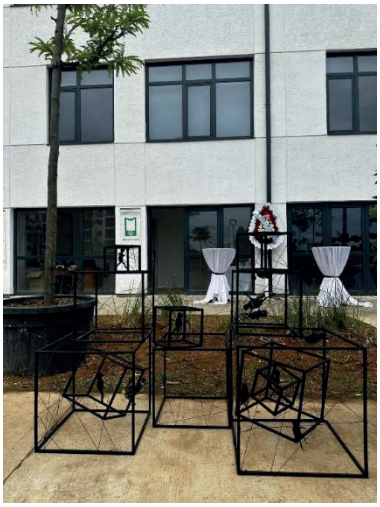
Basic design education constitutes a fundamental pillar in the discipline of landscape architecture, fostering students’ spatial perception, creativity, critical thinking, and problem-solving skills (Düzenli et al., 2018a). This educational process strengthens not only students’ formal design competencies but also their abilities in abstract thinking, conceptualization, and environmental awareness.

Landscape architecture education has an interdisciplinary structure that addresses the relationship between nature and humans on a spatial plane (Yılmaz et al., 2021). Basic design studios, which form the initial stage of this education, are the courses in which students first encounter design thinking in a systematic manner. By transforming intuitive productions into a conscious design language, basic design education lays the foundation for professional development. It aims to enable experiential learning of design elements and principles such as point, line, plane, texture, color, rhythm, balance, and hierarchy. Through this process, students develop visual perception and spatial thinking skills (Alpak et al., 2018; Düzenli et al., 2017; Ocakçı, 2011). In the context of landscape architecture, basic design allows the abstraction and interpretation of the natural and built environment, enabling students to evaluate their surroundings from an analytical perspective (Eren et al., 2018). The basic design process encourages students to move away from stereotypical modes of thinking and to generate original solutions (Düzenli et al., 2018b; Kuloğlu & Yavuz, 2015). The transformation of abstract concepts into physical models and drawings plays a significant role in the development of creativity (Düzenli & Alpak, 2016; Eren & Düzenli, 2021; Yavuz, 2015; Cross, 2006). Discussions and jury evaluations conducted in the studio environment strengthen students’ critical thinking skills (Bayramoğlu et al., 2019; Bayramoğlu & Seyhan, 2021). Students learn to defend their design decisions and to revise their work in response to feedback (Schön, 1987). Basic design education enables students to perceive landscape architecture not merely as a technical profession but as a holistic discipline encompassing cultural, social, ecological, and societal dimensions. This process contributes to the early formation of professional identity (Erdoğan & Aksoy, 2015). In the specific context of landscape architecture, it can also be argued that this education provides a foundation for the development of environmental sensitivity. Basic design education thus represents a critical threshold in the professional journey of landscape architecture students, revealing their creative potential while strengthening spatial perception, critical thinking, and the ability to develop a design language.

At the Department of Landscape Architecture at Karadeniz Technical University, the aim of the basic design and project courses is not merely to teach aesthetic approaches, but to provide students with an experiential process that develops their capacity to respond to environmental and social issues. Within this framework, as part of the final projects of the 2023–2024 Basic Design and Project course, memory space configurations were created that reflect the wounds caused by the earthquake that occurred in Türkiye on 6 February 2023.

The objective was to transform the physical and psychological devastation caused by the earthquakes into a powerful spatial narrative through the concept of the memory space (lieu de mémoire). These works by KTÜ Landscape Architecture students represent not only an aesthetic expression but also an effort to keep collective memory alive, make loss visible, and enable remembrance through space. The studies produced for this purpose are presented in Table 1.

Table 1. Spaces Designed to Prevent the Forgetting of the Earthquake, with the Landscape as a Carrier of Memory

11. Conclusions

The Relationship between Memory, Trauma, and Time

The memory spaces created through these studies assume the role of the landscape as a carrier of memory by transforming the earthquake from a "past event" into an ongoing trauma, an unresolved state of mourning, and a call for collective responsibility. In this way, the landscape does not merely commemorate the event but actively sustains its presence in social consciousness.

In the first example, the hands appear frozen as if in motion, suggesting that time was suspended at the moment of the earthquake. This interpretation supports one of the fundamental aims of memory spaces: resistance to forgetting. Fragmented surfaces are employed to symbolize the urban fabric reduced to rubble after the disaster and the rupture of everyday life. The hands emerging from beneath the surface represent people trapped under the debris, calls for help, and delayed or insufficient interventions. The anonymity of the hands points not to an individual narrative but to a collective trauma. In this respect, the work does not construct space as a conventional monument, but rather as a "constantly reminding wound."

Such works produced by KTÜ Landscape Architecture students:

• Focus on the human scale rather than the monumental scale,

• Articulate meaning through the body, void, and trace instead of grand narratives,

• Approach the landscape not merely as "green space" but as a carrier of collective memory.

These characteristics distinguish the proposed memory space from classical commemorative sites, transforming it into a more striking and contemporary example of a memory landscape. In conclusion, rather than softening the reality of the earthquake through aestheticization, this work consciously renders it disturbing, unsettling, and unforgettable, thereby successfully fulfilling its role as a memory space.

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CHAPTER 4

PLANTS WITH HIGH CARBON STORAGE CAPACITY

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1. INTRODUCTION

- **Climate Change and Rising Atmospheric CO_2 Concentrations**

Climate change is the observed global-scale change in climate components such as temperature, precipitation and wind over long periods of time and is often accelerated by human activities (Türkeş, 2008; Lemke et al., 2007). Scientific organizations such as the Intergovernmental Panel on Climate Change (IPCC) emphasize that the main cause of the current change is unquestionably the increase in greenhouse gases released into the atmosphere (Houghton et al., 2001).

The main causes of climate change observed today are largely based on human activities. The most important force is the use of fossil fuels, which increases the concentration of greenhouse gases released into the atmosphere. Carbon dioxide (CO_2) concentrations released into the atmosphere from the burning of fossil fuels such as coal, oil and natural gas have reached a dangerously high of 420 ppm today, from around 280 ppm before the industrial revolution. This is the main reason for the strengthening greenhouse effect (Houghton et al., 2001).

The second important reason is the destruction of forests, which are natural carbon sinks and retain CO_2 in the atmosphere. Industrial and agricultural activities also contribute significantly to climate change; especially because of livestock farming and fertilizer use, Methane (CH_4) and Nitrogen Oxide (N_2O), which are much more potent greenhouse gases than CO_2, are released into the atmosphere. Although natural factors such as volcanic eruptions and solar cycles have also had an impact on climate in the past, the dominant force behind the rapid change observed today is human-induced greenhouse gas emissions. (FAO, 2020).

The effects of climate change are clear in the rapid rise in global average temperatures, and this increase is particularly pronounced in regions such as the Arctic. Due to the increase in temperature, there are shifts in the seasonal cycle; spring and autumn periods are getting shorter, summers are getting longer and winters are starting later. Climate change directly affects water resources and the frequency of natural disasters. Rainfall regimes are becoming unpredictable, increasing both the severity and duration of drought periods and the frequency and destructiveness of floods due to sudden downpours (IPCC, 2021).

Turkey's greenhouse gas emissions have increased continuously from 1990 to 2023. According to greenhouse gas inventory data published by TÜİK, “Emissions, which were approximately 200–220 million tons of CO_2-equivalent in 1990, reached levels of 300–330 Mt in 2000, 400–420 Mt in 2010, 520–540 Mt in 2020, and 560–580 Mt in 2023.” (TÜİK, 2023). This trend shows that the increase in emissions has become more pronounced with the acceleration of energy consumption and industrialization, especially in the post-2000 period. This rising curve in the line chart visually reveals the challenges Turkey faces in combating climate change (Table 1).

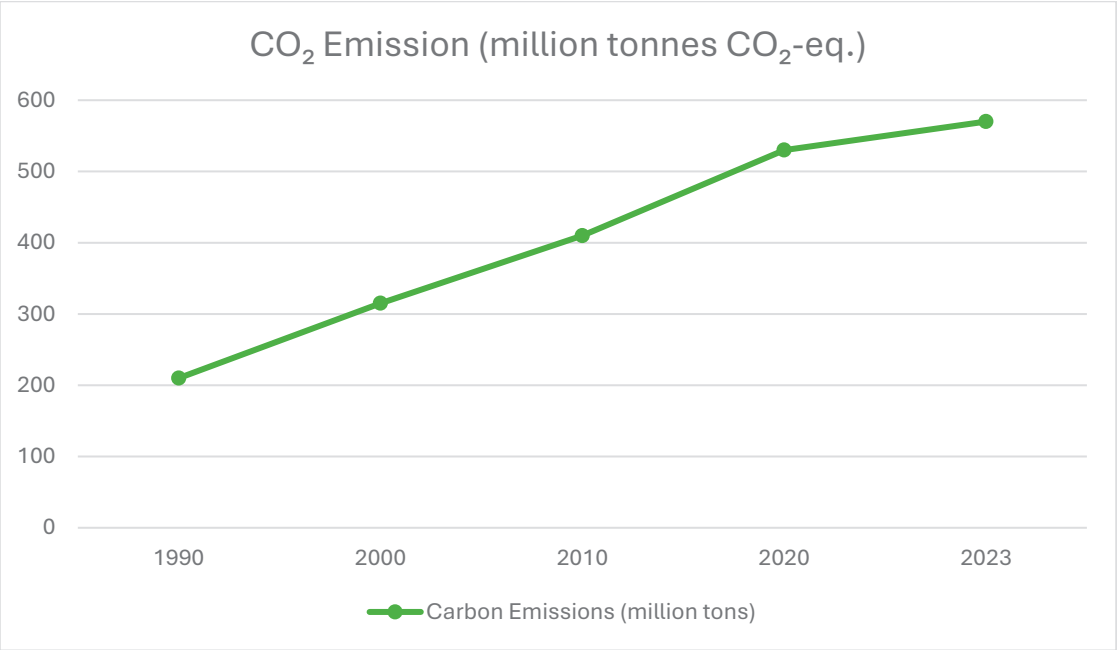

Table 1. Temporal Change in Turkey's Total CO_2 Emissions (1990–2023) (TÜİK, 2023).

According to Turkey's greenhouse gas inventory, the energy sector accounts for the largest share of CO_2 emissions. With respect to TÜİK's 2023 data, "energy-related emissions constitute approximately 70% of total emissions, with industry accounting for 14%, transportation 12%, agriculture 6%, and the waste sector 4%." (TÜİK, 2023). This distribution shows that the energy sector is a critical target in combating climate change. In the pie chart, the energy slice is highlighted as the largest, while other sectors are represented by smaller proportions. Thus, the visual helps identify priority areas in Turkey's emission reduction strategies (Table 2).

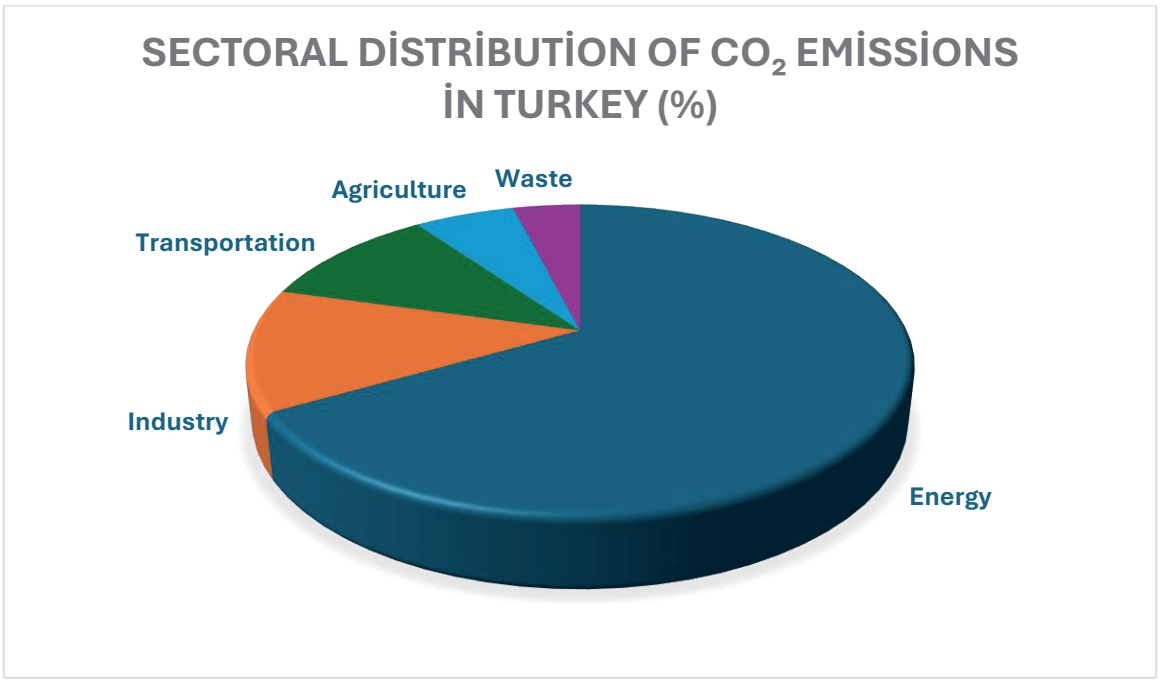

Table 2. Turkey's Sectoral CO_2 Emission Distribution (TÜİK, 2023).

• The role of plants in the carbon cycle

Plants are key factors in the carbon cycle. They convert CO_2 in the atmosphere into organic compounds through photosynthesis, store it in biomass and release some of it through respiration. This process directly affects the circulation of carbon in ecosystems and the course of climate change.

1. 1. Carbon Sequestration through Photosynthesis

Plants convert CO_2 from the atmosphere into organic carbon compounds through chlorophyll. This process is the most important mechanism of carbon immobilization in terrestrial ecosystems.

2. Biomass and Storage

Carbon is stored in the trunk, branches, leaves and roots of plants. Based on dry weight, plant tissues contain 40–50% carbon.

3. Respiration and Carbon Emission

During respiration, plants release some of their carbon back into the atmosphere as CO_2. This balance determines the carbon budget of ecosystems.

4. Photosynthesis Mechanisms

- C3 plants: The most common photosynthetic pathway, dominant in temperate climates.
- C4 plants: More efficient CO_2 assimilation capacity, advantageous in hot and arid regions.
- CAM plants: Can assimilate CO_2 at night, reducing water loss, common in desert plants.

5. Ecosystem and Climate Impact

Plants ensure that atmospheric carbon is continually converted into organic carbon. This transformation enables the formation of organic substrates necessary for heterotrophic organisms. Field crops and forest ecosystems play critical roles in mitigating the effects of climate change. Plants participate in both the source and storage parts of the carbon cycle. They reduce CO_2 in the atmosphere through photosynthesis and release carbon back through respiration and decomposition processes. This dual role is one of the most critical biological mechanisms determining the course of climate change (Katkat, 1985; Mirza & Çopur Doğrusöz., 2025; Gulpınar Sekban, 2025).

The climate change-adaptive design of urban open spaces offers nature-based solutions that strengthen the role of plants in the carbon cycle (Gulpınar Sekban & Acar 2024).

• The impact of carbon sequestration as an ecosystem service on landscape planning

The contributions of carbon sequestration as an ecosystem service have become an increasingly strategic component in landscape planning and design processes. Carbon sequestration through vegetation, soil and especially woody species plays a critical role in mitigating the effects of climate change, thus directly contributing to increasing ecological resilience (Lal, 2004). Afforestation, green corridors, ecological networks and protection of forested areas in urban areas not only increase carbon storage capacity but also provide additional services such as microclimate regulation, air quality improvement and biodiversity support (Nowak & Crane, 2002). Therefore, carbon sequestration is considered not only as an indicator of environmental sustainability in landscape planning, but also as a functional criterion that guides planning decisions. Considering the impact of landscape-scale

interventions on the carbon cycle necessitates the redesign of land use patterns, the dissemination of ecosystem-based solutions, and the development of long-term climate adaptation strategies (Canadell & Raupach, 2008). In this context, landscape planning sensitive to carbon sequestration is considered a fundamental approach for optimizing ecosystem services and creating sustainable living environments.

2. Carbon Sequestration Mechanisms

Carbon sequestration mechanisms involve the processes of removing carbon from the atmosphere in ecosystems and storing it in biomass, soil or geological structures, and these processes are of critical importance for landscape planning. Plants convert atmospheric CO_2 into organic carbon forms through photosynthesis, and a significant portion of this carbon is stored long-term in structural components such as stems, leaves, and roots (Lal, 2008). But carbon storage is not limited to plant biomass; soils can hold carbon for hundreds of years through plant roots, microbial activity and the accumulation of organic matter, forming one of the largest terrestrial carbon sinks on Earth (Jobbágy & Jackson, 2000). Forest ecosystems are one of the landscape types with the highest carbon sequestration capacity due to their multi-layered vegetation structures and high primary production (Pan et al., 2011). However, despite their potential to produce methane, wetlands stand out as effective systems for long-term carbon storage thanks to their high organic matter accumulation (Mitsch & Gosselink, 2015).

Another factor that determines carbon sequestration capacity at the landscape scale is the level of degradation of ecosystems. Land use changes, particularly urbanization and agricultural expansion, lead to a reduction in carbon storage potential, while reforestation, agroforestry practices, and natural habitat restorations can significantly increase carbon sequestration (Griscom et al., 2017). In addition, structural characteristics, growth rates and wood density of tree species are the main factors determining the spatial distribution of carbon accumulation in the landscape (Keith et al., 2009). Therefore, understanding carbon sequestration mechanisms is vital not only for explaining ecological processes but also for developing landscape planning strategies targeting climate change mitigation.

3. Plant Groups with High Carbon Sequestration Capacity

Plant groups with high carbon retention capacity make a significant contribution to the long-term storage of atmospheric carbon dioxide in terms of both their morphological and physiological characteristics and the ecosystem structures they form. Turkey's ecological diversity, diverse climatic zones and rich flora enable the discovery of a wide variety of species with carbon storage potential. Forest ecosystems are Turkey's most important natural carbon sinks in terms of biomass and soil carbon. Oriental beech (*Fagus orientalis*), spruce (*Picea orientalis*) and Oriental fir (*Abies nordmanniana subsp. equi-trojani*), which are distributed in the Black Sea Region, are among the species with the highest carbon storage capacity due to their high wood density and long lifespan (Ozdogan, et.al, 2016). These species provide significant accumulation of soil carbon, both in upper biomass and through slowly decomposing leaf litter.

Oak species (*Quercus cerris, Q. frainetto, Q. petraea, Q. ithaburensis*) that have a wide distribution area in Turkey also stand out as important carbon storage species. These species, which form natural forest formations in a large part of Anatolia, increase carbon accumulation both in biomass and in the deep layers of the soil, thanks to their hard wood structures and deep root systems. In addition, Red Pine (*Pinus brutia*) and Scots Pine (*Pinus sylvestris*) are species that contribute highly to Turkey's

carbon sink capacity, especially with their fast growth rates and widespread forest areas. Red pine forests support carbon storage in the Aegean and Mediterranean regions with their rapid post-fire regeneration properties, while Scots pine forests support carbon storage with the accumulation of slowly decomposing organic matter in high altitude and low temperature conditions (Tolunay, 2011).

Shrub-form plant communities also have an important place in terms of carbon storage, especially in Turkey's Mediterranean climate zone. Maquis and garig ecosystems preserve soil organic carbon thanks to their dense root structures and prevent carbon loss by reducing erosion. Species such as arbutus (*Arbutus unedo*), laurel (*Laurus nobilis*), and shrubs (*Rhododendron ponticum, R. luteum*) are important shrub groups that contribute to the retention of carbon both in the upper biomass and in the soil, especially in the Black Sea and Mediterranean regions. The dense and densely textured structure of *Rhododendron ponticum*, native to the Black Sea Region, is notable for carbon accumulation thanks to its high annual biomass production (Güner, et.al., 2012).

Turkey's wetlands also contain plant groups with high carbon sequestration potential. Species such as *Phragmites australis* (reed), *Typha domingensis / Typha latifolia* (cranberry) and *Carex spp.* allow organic matter to accumulate without decay, thanks to both their rhizome systems and high biomass production. Wetlands, especially the Manyas Bird Sanctuary, the Kızılırmak Delta, the Göksu Delta and the Yedigöller peatlands, are considered to be the most important natural carbon storage areas in Türkiye. In these areas, the slow decomposition of plant tissue under anaerobic conditions leads to peat formation, providing long-term carbon storage (Güner, et.al., 2012).

Although steppe vegetation, which is widespread in the semi-arid Central and Eastern Anatolia regions of Turkey, does not have as high a biomass capacity as forests, it stores a significant amount of soil carbon thanks to its root depth and density. Species such as *Astragalus spp.* (Astragalus), *Artemisia fragrans, Stipa holosericea, Thymus spp*. contribute to the retention of carbon, especially in the form of soil organic matter, in steppe ecosystems. Steppe ecosystems are important systems that provide long-term carbon accumulation in deep layers of the soil due to low decomposition rates (Ketenoğlu & Kurt, 2012).

In conclusion, Türkiye's wide ecological diversity enables different plant groups to make separate but holistic contributions to carbon storage. Integrating species found in forest, maquis, shrubland, wetland and steppe ecosystems into landscape planning carries significant strategic potential for mitigating the effects of climate change (Table 3).

Plant Group	Sample Species	Carbon Storage Feature	Growth Rate / Life Span
Forest Trees	Pine (*Pinus spp.)* Spruce (*Picea spp.)* Fir (*Abies spp.)* Oak (*Quercus spp.)* Beech (*Fagus spp.)* Walnut (*Juglans spp.)*	Dense wood texture, long-term carbon storage	Slow growing, long lasting
Wetland Plants	Mangrove (*Rhizophora spp., Avicennia spp.)* Reeds (*Phragmites australis)* Reed (*Arundo donax*) Water Lily (*Nymphaea spp.)*	High carbon accumulation around the roots and in the soil	Medium-speed, ecosystem-focused

Shrub and Woody Species	Olive (*Olea europaea*) Chestnut (*Castanea sativa)* Acacia (*Acacia spp.)* Laurel (*Laurus nobilis*)	It retains carbon for a long time with its long-lasting, woody structures.	Medium-slow growth, long lifespan
Herbaceous and Fast Species	Bamboos (*Bambusoideae*) Clover (*Medicago sativa*) Meadow grasses (*Poaceae family*)	Produces high biomass in a short time with rapid growth	Very fast growing, short lived
Indoor Plants	Rubber plant (Ficus elastica) Peace lily (Spathiphyllum spp.) Dieffenbachia spp.	Reduces CO_2 levels, limited carbon storage	Medium speed, decorative purposes

Table 3. Plant Groups with High Carbon Sequestration Capacity

4. Ecological and Design Perspective

Landscape planning to increase carbon sequestration requires not only the protection of ecological processes but also the construction of spatial arrangements that will positively contribute to the carbon cycle. In this context, considering the carbon sequestration performances of different plant species and their functional roles within the ecosystem allows the creation of a multi-layered landscape composition that reduces the carbon footprint. Ecologically, preserving natural species compositions and forest formations is critical for increasing soil organic carbon, ensuring biomass continuity and maintaining habitat integrity (IPCC, 2021; Lal, 2020). Therefore, in different ecoregions of Turkey—for example, in the humid forests of the Black Sea or the red pine-dominated maquis landscapes of the Mediterranean—the adaptation advantages of local species support the long-term stability of carbon sequestration potential.

From a design perspective, carbon sequestration-focused landscape planning is directly related to species selection, plant density, planting pattern and multi-layered planting strategies. Polycultural arrangements, particularly those that use a combination of tree, shrub, and herbaceous layers, offer higher carbon storage capacity compared to monocultural designs (Nowak & Crane, 2002). In urban areas, green corridors, permeable surfaces, trees with large crowns and green infrastructure elements (green roofs, vertical gardens, etc.) not only sequester carbon but also indirectly reduce carbon emissions by reducing the heat island effect (Gill et al., 2007). In this context, integrating landscape planning processes not only with aesthetic and functional requirements but also with ecosystem-based carbon management objectives is considered a fundamental requirement for sustainable environmental design.

4.1. Example Ecological and Planning Practices from Turkey

Ecologically based planning approaches that support carbon sequestration in Turkey are shaped particularly through forest ecosystems, urban green spaces and protected area management. For example, the dense tree cover in the Atatürk Arboretum and the Karadeniz Technical University campus in Istanbul functions as urban carbon storage areas thanks to the continuous accumulation of biomass. The Izmir Metropolitan Municipality's Green Infrastructure Strategy sets an example for local carbon management with its practices aimed at strengthening green corridors and increasing

urban tree density (İzmir Büyükşehir Belediyesi, 2018). Ecological restoration of Eskişehir Porsuk Basin has also increased carbon storage capacity through strengthening of riparian vegetation. These practices show that carbon sequestration in Turkey can be managed not only through forests but also through urban landscapes and coastal ecosystems.

4.2. City-Scale Design Suggestions

Species selection, plant density and multi-layered planting strategies are important in increasing carbon sequestration in urban areas. The use of local species ensures sustainability in carbon sequestration, especially thanks to the adaptation advantages of species such as *Quercus cerris, Fagus orientalis* and *Acer cappadocicum*, which are common in Anatolia (Atalay, et.al., 2024). Planning green corridors and urban forest cores both increases habitat continuity and expands carbon storage capacity within the city (Tülek & Mirici, 2019). In addition, green roofs, vertical gardens and permeable surface applications not only directly contribute to carbon sequestration but also indirectly reduce energy consumption by reducing the heat island effect (Gill et al., 2007). Therefore, considering carbon sequestration as a design criterion at the city scale is critical for the integration of ecosystem services into planning processes.

4.2.1. Trabzon: Urban Afforestation Practices

Trabzon is one of the rare urban centers where natural forest formations can be sustained thanks to its humid-temperate Black Sea climate and high precipitation regime. This climatic advantage provides favorable conditions for the successful use of species with high carbon sequestration capacity in urban afforestation efforts. Green area development and afforestation practices carried out in recent years, especially in Ortahisar, Yomra and Akçaabat districts, are remarkable in terms of prioritizing local species and increasing ecosystem services. Eastern beech (*Fagus orientalis*), spruce (*Picea orientalis*), alder *(Alnus glutinosa*) and oak species (*Quercus spp*.), which are frequently used in the city, make a significant contribution to the urban carbon stock thanks to their high biomass production and rapid carbon accumulation. Afforestation practices carried out in erosion-sensitive slope areas support not only carbon sequestration but also ecosystem services such as reducing surface runoff, strengthening soil stability and ensuring ecological corridor continuity (Güneroğlu & Bekar, 2022).

In terms of urban design, the green corridor approach implemented in Trabzon in recent years aims to increase carbon sink areas by restoring natural vegetation, especially in the Tabakhane Valley and Zağnos Valley urban transformation areas. The use of multi-layered planting strategies allows the use of shade, microclimate regulation and long-term carbon storage capacity of local trees with wide crown structures. In addition, new afforestation efforts in coastal walkways and park areas contribute to reducing the urban heat island effect and create a strong integration between urban ecology and landscape aesthetics (Kahraman & Şenol, 2018). In this context, Trabzon constitutes an important example of sustainable landscape management based on carbon sequestration by integrating its natural flora diversity into urban planning processes (Table 4).

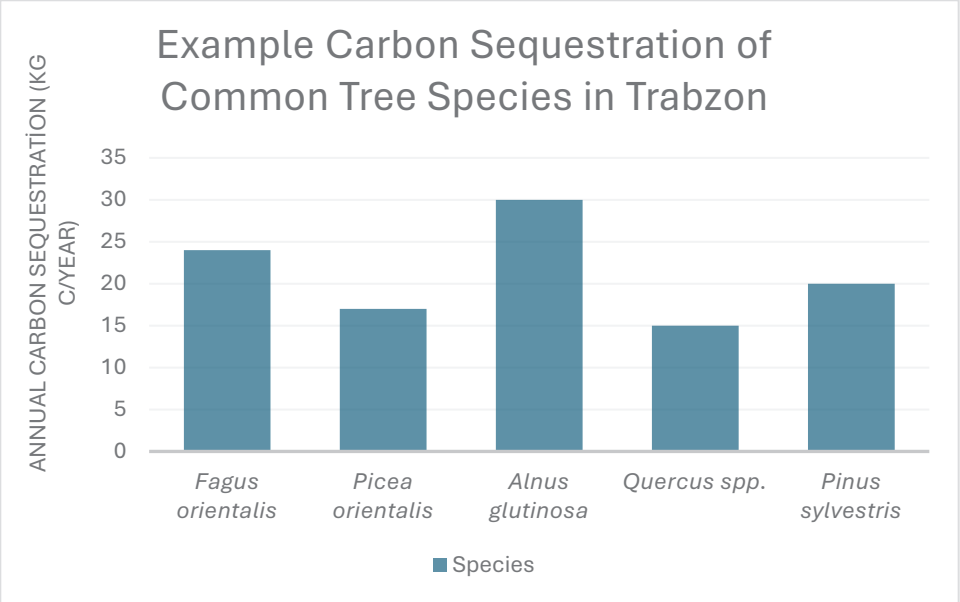

Table 4. Carbon sequestration potential assessment of urban trees in Trabzon (Güneroğlu & Bekar, 2022).

5. Conclusion and Recommendations

The strategic use of plant species with high carbon sequestration capacity in landscape planning has become a critical necessity for both combating climate change and maintaining ecological integrity. Trees, shrubs, and especially species with strong local-ecological adaptations, play an important role in reducing the carbon footprint of cities by storing atmospheric carbon in biomass and soil systems throughout their life cycles (Nowak et al., 2013; Lal, 2008). Therefore, carbon sequestration capacity should be considered as a design input in landscape design, and species selection should be guided not only by aesthetic criteria but also by ecosystem services.

Studies conducted specifically in Türkiye show that species such as beech, oak, cedar, red pine and black pine have high carbon storage potential both in forest ecosystems and in urban areas (Tolunay & Çömez, 2007; Çömez et al., 2019). These findings suggest that prioritizing local and endemic species in landscape projects provides double-sided benefits for both biodiversity and carbon management. In addition, exotic species used in urban areas are known to reduce carbon storage efficiency in the long term due to ecological adaptation problems (Kendal et al., 2017). Therefore, sustainability principles should be more decisive in species selection.

In order to ensure ecological and aesthetic integration in landscape design projects, it is necessary to implement design strategies that increase carbon sequestration. These include multi-layered planting, increasing permeable surfaces, strengthening green corridor connections, expanding urban forests and supporting natural succession processes in open spaces (Nowak et al., 2000).

As a result, the widespread use of plant species with high carbon sequestration capacity, the prioritization of local species, and the provision of ecological-aesthetic integration in design projects should be the fundamental components of sustainable landscape planning. This approach will both increase the capacity to combat climate change and contribute to the protection of biodiversity.

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