

EVALUATION OF TOKAT CITY PARK IN TERMS OF XERISCAPE DESIGN APPROACHES



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(Received 21st February 2023; accepted 26th April 2023)

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ABSTRACT. One of the biggest problems brought by urbanization is drought. With the effect of global warming, drought is increasing rapidly in the world and is seen as a danger that will confront humanity with thirst soon. This problem has encouraged ecology-focused professional disciplines to produce new approaches to managing the process. One of the professional disciplines that produces new approaches to this subject is landscape architecture. Vegetable areas and especially grass areas in urban areas are the areas with the highest water consumption. Many approaches have been put forward to reduce and use water effectively in urban landscape areas. One of these approaches is the Arid Landscape approach, which is based on the effective use of water, prevents excessive water use, prefers natural plant species in vegetative studies, and is based on open green area planning principles in which grass surfaces are reduced as much as possible. In this study, the city park located in Tokat city center was discussed. By considering Tokat City Park, its current situation in terms of xeric landscape design principles was evaluated and suggestions were developed to correct the features that do not coincide with xeric landscape design principles. Within the scope of the research method, 7 principles and 45 criteria regarding xeric landscape design were created, and the relationship between the principles created by field studies and the current situation was established. As a result of the study, it was determined that there was not enough space to collect rainwater in Tokat City Park, the plants were not zoned according to their water needs, soil analysis was not done before the applications, the plant species used were not natural but were resistant to drought, mains water was used as irrigation water, and mulching was not done to save water.

Key Words: drought, xeriscape, design, natural plant, city park, tokat

INTRODUCTION

Urbanization, which brings with it many environmental problems of today, especially the sustainability of cities, also causes rapid depletion of natural resources [1]. In the process of industrialization and urbanization, people trying to create a new way of life have caused deterioration in nature and the ecosystem[2]. Pollution and greenhouse gas emissions are mostly caused by cities and the inhabitants of cities are directly affected. Cities therefore have a special responsibility to effectively reduce the causes of climate change [3]. Extreme weather events (drought, flood, hurricane, etc.), especially as a result of climate changes, and the ability to meet the increasing population and industrial needs have further triggered this situation, bringing natural resources, especially water resources, to the brink of depletion in cities [4]. Stopping the environmental problems that arise in parallel with the increasing developments of the age and ensuring the protection of the ecosystem has been the starting point of the concept of sustainability [5]. Sustainability, which is one of the most important concepts of the 20th century, is defined as preserving and maintaining existing resources for the needs of future

generations without consuming or degrading them [6]. At the same time, this continuity; is aimed to do this without endangering living life, by ensuring the balance between humans and nature, by providing clean living spaces, and by finding solutions to the negativities that may be encountered [7]. Another concept that emerged for this purpose is urban sustainability, which emerged as a search for solutions to problems related to unplanned urbanization and excessive and unbalanced land use that occur due to agglomerations in cities [8]. With the emergence of the concept of a sustainable city, ecological planning approaches that enable urban spaces to be environmentally sensitive have gained importance in landscape designs [9]. Some basic principles were adopted with the ecological design approach developed by McHarg in 1969 [10]. These principles compiled are listed below;

- Preservation of existing landscape character,
- Design following ecological conditions and climatic data,
- Use of local resources in design
- Water efficient landscape design, Xeriscape,
- Energy-efficient landscape design,
- sustainable agriculture,
- Use of renewable energy resources,
- Green roof and green wall applications,
- Creation of alternative green areas, design appropriate to ecological conditions and climatic data.

Water is the most necessary resource for living things to fulfill their vital functions. Today, the availability, quantity, quality, and usage patterns of water pose a threat to water resources [11]. Especially the decrease in water resources disrupts the sustainability of nature; It causes many problems such as drought, erosion, a decrease in plant diversity, loss of productivity in agricultural areas, and natural disasters [12]. Which requires a better understanding of the importance of water. Cities are the places where the habitats of plant and animal species are disturbed the most. Thus, the physical structure of landscapes changes, natural lands are fragmented, and the balance of the unique ecosystems and water resources of the region is disrupted [13].

Landscape design works are one of the most intensively used areas of usable water in the World [12]. In classical landscaping arrangements made in open green areas, it is becoming more and more difficult to meet the water needs of plant materials with existing water resources [14]. Especially in landscaping arrangements, plants with high water demand and the preference for grass areas, which are among the areas where water is used most, cause excessive water use [15]. For this reason, landscape architects have introduced many approaches to reduce the use of water in landscaping. In these approaches, it has been revealed that plants that require little water should be preferred instead of plants that require excessive water, that plant species should be selected from natural species in the ecology of the region, that plants should be irrigated considering their water requirements, and that ground covers with low water requirements should be preferred instead of large grass areas [16]. In this context, the xeriscape approach(Xeriscape), which embraces the effective use of water, has emerged. The xeric landscape design was created by the Colorado Water Department as a planting style by landscape architects to find a solution to the water shortage in Denver, USA. The xeric landscape approach, which is gradually spreading to other states, has become a globally accepted understanding instead of the local landscape understanding [17].

In addition, xeric landscaping is a design approach that allows maximum use of existing water resources, taking into account the natural ecology of a region. To implement an xeric landscape design, it is not necessary to redo the entire landscape, it

can be done by rearranging the existing design. The xeric landscape approach aims to protect water resources by minimizing water use; It has 7 basic principles: planning and projecting, soil preparation, selection of appropriate plants, limiting the lawn to suitable and functional areas, effective irrigation, use of mulch and appropriate maintenance [18;19].

This study was conducted to evaluate the "Tokat City Park" built between 2021-2022 in Tokat city center in terms of xeric landscape design approaches and to develop solution suggestions.

MATERIALS AND METHOD

Material

Study Area

Tokat province is one of the provinces located in the Black Sea Region of Turkey. It borders Samsun in the north, Ordu in the northeast, Sivas in the east and south, Yozgat in the southwest, and Amasya in the West. Its districts, Yeşilyurt and Sulusaray, are located in the Central Anatolia Region. Its surface area is 10,072 km² and its altitude is 623 meters [20]. Its population is 602,567 people [21]. The average annual temperature of Tokat province is 12.5 °C, the average highest temperature is 18.8 °C, the average lowest temperature is 7.2 °C, and the average annual precipitation is 434.5 mm [22]. The highest precipitation occurs in May with 58.0 mm, in April with 53.7 mm, and the least precipitation occurs in August with 8.6 mm [23]. The location of the study area is given in Figure 1.



Fig. 1. Location of the Study Area
(By using [24, 25] and Google Earth satellite image)

'Tokat City Park', which is used as a study area, is located in the city center and was used as an institutional garden in a state institution (DSI). In 2021, it was leased by Tokat Municipality for 49 years and restored and opened to public use as a recreational area. Tokat Municipality City Park was completed in one year on an area of 20 540 m². There are walking paths, bicycle paths, a biological pond, a ladies' cafeteria, a cafeteria, a toilet, a masjid, an amphitheater, a children's playground, and many landscaping areas. Since the park is located in the city center, it is very easy to reach. It is within walking distance

of the city center shopping center and the city stadium. General views of Tokat City Park are given in Fig. 2.

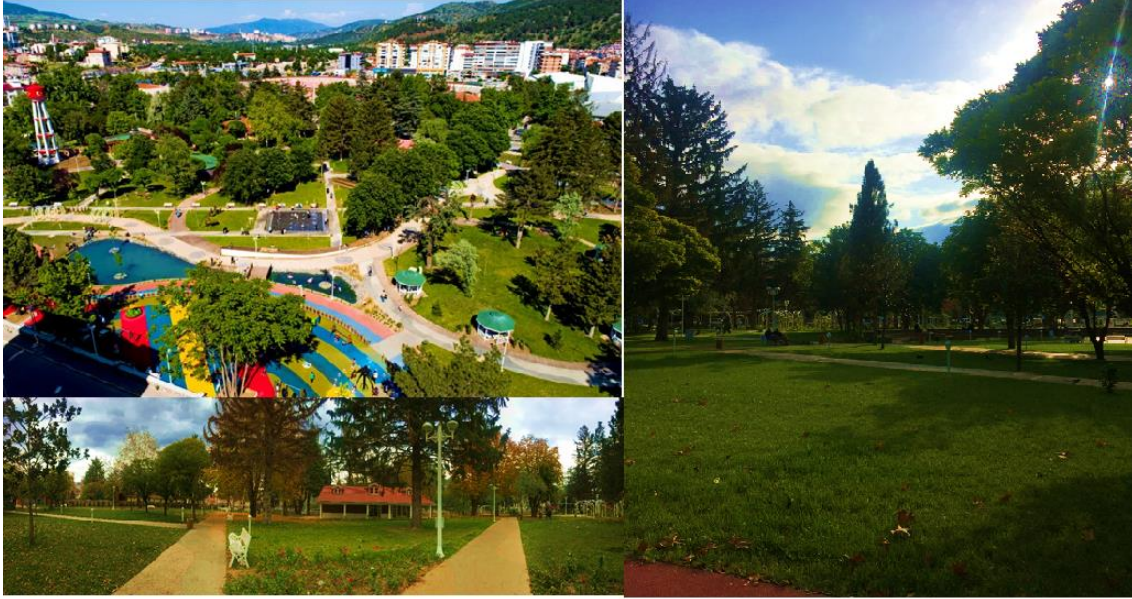


Fig. 2. General Views from Tokat City Park
(Original, 2022 and by utilizing [26])

The usage areas of Tokat City Park and the amount of area it covers are given in Table 1.

Table 1. Areas of Use and Amount of Area Covered (m^2)

Usage Area/Covered Area (m^2)	Usage Area/Covered Area (m^2)
Green Areas/16.500 m^2	Biological Pond/135 m^2
Children's Playground/1100 m^2	WC, Masjid/110 m^2
Ladies' Coffeeshouse/200 m^2	Main Entrance Staircase/400 m^2
Cafeteria/220 m^2	Door (Evacuation) Various Exit
Dry Dock/110 m^2	Door/140 m^2
Total Area/ 20.540m^2	Walking Paths/2000 m^2

Method

The method of the study consists of data collection-analysis-synthesis and evaluations. The most important data collection tool is the field information collection form prepared for the study and given in Table 2. In these forms, there are 10 criteria for principle A (planning and projecting), 4 criteria for principle B (soil preparation), 9 criteria for principle C (appropriate plant selection), 8 criteria for principle D (limiting the grass to suitable and functional areas), E 8 criteria were determined for principle (effective irrigation), 2 criteria for principle F (Use of mulch) and 4 criteria for principle G (appropriate care). The 7 principles of xeric design in the created table and the criteria associated with that principle were filled in with on-site examinations, and evaluations were made by synthesizing them with literature information. Field studies were carried out on 18 October - 18 November 2022 and 17 April 2023.

Table 2. Xeric Landscape Design Principles and Criteria

Name of the Park: Tokat City Park City/District/Neighbourhood: Tokat /Merkez/Yeni Mahalle Size of the Park (m ²):20.540 m ²		E	K	H
Basic Principles	Criteria			
A-Planning and Projecting	1	The general landscape character of the area has been preserved		
	2	There are trees in the park to provide shade		
	3	The slope of the area is suitable for natural drainage		
	4	Terracing was done for water loss		
	5	Drainage of structural areas is suitable for collecting rainwater		
	6	Special areas have been built to collect rainwater		
	7	There is a building mass or plant element that borders the park		
	8	Hard floors have permeable properties		
	9	A sufficient amount of green space was used		
	10	The areas are divided according to the water needs of the plants (Zone I, Zone II, Zone III)		
B-Soil Preparation	1	Vegetable soil was laid		
	2	Soil analysis was carried out before the project		
	3	Fill soil was used in the area		
	4	The soil is sufficiently permeable		
C-Appropriate Plant Selection	1	Plants were selected from ecologically suitable species		
	2	Plants with low water consumption were used		
	3	Plants tolerant to extreme conditions were used		
	4	Adapts to fluctuations in soil moisture (can survive periods of heavy rainfall)		
	5	The root structure of the plants is suitable for xeric landscaping		
	6	The above-ground structure of the plants is suitable for arid landscaping (prickly, grey, hairy, fleshy, etc.)		
	7	Plants were selected from natural cover species		
	8	The size and form of the plants are suitable for xeric landscaping		
	9	Natural plants, if any, in the area have been preserved		
D-Limiting The Grass To Suitable and Functional Areas	1	The grass was not used in sloping areas		
	2	There are large grass areas		
	3	Grass areas are applied in one piece or connection with each other		
	4	Grass species are suitable for the climatic characteristics of the city		
	5	The grass area is resistant to arid conditions		
	6	Artificial grass is used in the area		
	7	The grass area is resistant to pressure and wear		
	1	Drip irrigation system is used		
	2	Grass areas are irrigated with a low-pressure sprinkler irrigation system		
	3	Irrigation system is connected to automation		

E- Effective Irrigation	4	Irrigation hours are after sunset or early in the morning
	5	Irrigation heads are placed in accordance with water saving
	6	Water resources are used effectively (rain water, natural water source etc.)
	7	Irrigation water is obtained from wastewater
	8	Sprinklers of the irrigation system are placed considering the prevailing wind direction
F- Use of Mulch	1	Organic mulch was used (plant bark, leaves, etc.)
	2	Inorganic mulch was used (stone, rock, gravel, plastic sheet, etc.)
G- Appropriate Care	1	Correct pruning has been carried out
	2	Regular weed control is carried out
	3	Regular fertilization is done
	4	Fighting against diseases and pests is carried out
E: Yes K: Partially H: No		

FINDINGS

Findings on Planning and Project Design

Regarding planning and projecting; It is necessary to pay attention to the landforms, purpose of use, climate, and ecology of the area. The drainage of the area should allow natural drainage, and the drainage network should be expanded with rainwater collection areas. Plants should be planted by dividing them into zones according to their water needs [27]. The findings obtained regarding "Planning and projecting" for the study area are given in Table 3. According to this; It was determined that 6 of the 10 criteria were suitable for Xeric landscape design, 1 of them was partially suitable for xeric landscape design and 3 of them were not suitable.

Table 3. Planning and Project Criteria Evaluation Table

Basic Principles	Criteria	E	K	H	
A-Planning and Projecting	1	The general landscape character of the area has been preserved	X		
	2	There are trees in the park to provide shade	X		
	3	The slope of the area is suitable for natural drainage	X		
	4	Terracing was done for water loss			X
	5	Drainage of structural areas is suitable for collecting rainwater	X		
	6	Special areas have been built to collect rainwater			X
	7	There is a building mass or plant element that borders the park	X		
	8	Hard floors have permeable properties			X
	9	Sufficient amount of green space was used	X		
	10	The areas are divided according to the water needs of the plants (Zone I, Zone II, Zone III)			X
E: Yes K: Partially H: No					

While the area was previously used as an institutional garden, it was opened to public use by making arrangements. While making arrangements in the area, the general landscape character of the area was preserved. The amount of green area constitutes 80% of the total area, and the amount of green area is balanced and sufficient considering the building masses and other usage areas. The dimensions, placement, aesthetic-functional appearance, and use of the building masses and vegetative elements do not disturb the general landscape character of the park. Landscape design has been completed by planting new plants in a way not to harm the originality of the area, but since the existing plant presence was not divided into zones according to the water needs of the plants, this was not taken into consideration during the arrangement.

The distribution of grass areas within the area, the number of reinforcement elements, and their locations in the area were placed per the landscape design. To provide shading, *Abies nordmanniana* (Caucasian Fir), *Acer platanoides* 'Chrimson King' (Red Leaf Maple), *Aesculus hippocastanum* (White Flowered Maple), *Albizia julibrissin* (Gülibrissin), *Betula alba* (Birch), *Carpinus spp.* (Horbeam), *Gingko biloba* (Shrine Tree) and *Salix babylonica* (Weeping Willow) were used. Although the area is perceived as a flat area, it is suitable for natural drainage as it has a slope that will allow surface flow, and no extra terracing has been done for water loss. Moreover, while the stone floors used in the park are waterproof, the floor coverings used in walking paths and children's playgrounds are permeable. No special areas have been built to collect rainwater in the area, which does not comply with the purpose of xeric landscape design as it requires the use of excess tap water for irrigation. Views of the plan and project findings are given in Fig. 3.



Fig. 3. Views of Plan and Project Findings (Original, 2022)

Findings on Soil Preparation

Soil is most important for the healthy growth and development of plants. The ideal soil for plants is rich in organic matter, contains the plant nutrients the plant needs, is permeable, retains moisture well, and is free from diseases and pests. Soil analysis should be done before planting, compost, and burnt manure should be used [28]. When the soil preparation data in Table 4 was examined, it was determined that 3 criteria were suitable for xeric landscape design and 1 criterion was not suitable for xeric landscape design.

Table 4. Soil Preparation Criteria Evaluation Table

Basic Principles	Criteria	E	K	H
B-Soil Preparation	1 Vegetable soil was laid	X		
	2 Soil analysis was carried out before the project			X
	3 Fill soil was used in the area	X		
	4 The soil is sufficiently permeable	X		

E: Yes K: Partially H: No

According to the information obtained from the interviews with the authorities of the institution; during the landscape design of the area, fertilized vegetative soil and filling soil were applied only where needed. No soil analysis was conducted before the project. This means using too much water, applying more nutrients to the plant than it needs, fighting against deficient or incorrect diseases and pests, and not complying with the xeric landscape design. Permeable soils have an important place in the passage of rain and irrigation water to the plant body and in xeric landscape design. The area is permeable in terms of soil properties and was found suitable for xeric landscape design in terms of this criterion.

Findings on Appropriate Plant Selection

Plant selection is very important in xeric landscape designs. Plants to be planted should be selected from drought-resistant and natural species suitable for the ecology of the region. Natural species require less water than exotic species and are more resistant to diseases and pests. These plants, which are a part of the natural balance, have very important ecological functions in repairing the ecosystem, creating habitats for other living creatures, and ensuring the continuity of these habitats [29]. When the findings regarding the selection of suitable plants given in Table 5 were examined, it was determined that 5 of the 9 criteria were found to be suitable for xeric landscape design, 2 of them were found partially suitable and 2 of them were not suitable for xeric landscape design criteria.

Table 5. Appropriate Plant Selection Criteria Evaluation Table

Basic Principles	Criteria	E	K	H
C- Appropriate Plant Selection	1 Plants were selected from ecologically suitable species	X		
	2 Plants with low water consumption were used		X	
	3 Plants tolerant to extreme conditions were used	X		
	4 Adapts to fluctuations in soil moisture (can survive periods of heavy rainfall)	X		
	5 The root structure of the plants is suitable for xeric landscaping	X		

6	The above-ground structure of the plants is suitable for arid landscaping (prickly, grey, hairy, fleshy, etc.)	X
7	Plants were selected from natural cover species	X
8	The size and form of the plants are suitable for xeric landscaping	X
9	Natural plants, if any, in the area have been preserved	X

E: Yes K: Partially H: No

Of the plants found in the area, 86 % (49 of them) are exotic species and 14 % (8 of them) are native species. Although most of the plants are exotic species, they are suitable for drought-adapted to the ecology of the region. All of the plants are non-endemic species. While 7 of the plants in the area consist of exotic species that are not suitable for drought, 42 of the remaining exotic species are suitable for drought, and all of the natural species are suitable for drought. In addition, plants with low-medium water demand constitute the general flora of the park. Plants are species that are resistant to extreme conditions. *Acer* spp. in the field. *Abies nordamanniana*, *Albizia julibrissin*, *Aesculus hippocastanum*, *Aesculus carnea 'Briotii'*, *Salix babylonica* are trees that were previously found, and the presence of these plants is preserved during restoration. It has been observed that when choosing area plants, they were chosen completely by chance, not by considering the principles of xeric landscape design. Natural-exotic status, endemism status, and drought suitability status of the plants are given in Table 6.

Table 6. Natural-Exoticity, Endemism and Drought Suitability Status of Plants (By using these resources [30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41]).

BOTANICA L NAME	N/EX O	E S	DR P	BOTANICA L NAME	N/EX O	E S	DR P
<i>Abies nordamanniana</i>	N	NE	DS	<i>Liriodendron tulipifera</i>	EXO	NE	DS
<i>Abelia grandiflora</i>	EXO	NE	DS	<i>Magnolia spp.</i>	EXO	NE	DS
<i>Acer</i> spp.	EXO	NE	DS	<i>Mahonia aquifolium</i>	EXO	NE	DS
<i>Acer platanoides 'Chrimson King'</i>	EXO	NE	DS	<i>Morus alba 'Pendula'</i>	EXO	NE	DS
<i>Aesculus hippocastanum</i>	EXO	NE	DS	<i>Quercus ilex</i>	N	NE	DS
<i>Aesculus carnea 'Briotii'</i>	EXO	NE	DS	<i>Quercus robur</i>	EXO	NE	DS
<i>Albizia julibrissin</i>	EXO	NE	DS	<i>Quercus rubra</i>	EXO	NE	DS
<i>Aucuba japonica</i>	EXO	NE	DS	<i>Nandina domestica 'Nana'</i>	EXO	NE	DS
<i>Berberis thunbergii 'atropurnurea'</i>	EXO	NE	DS	<i>Nerium oleander</i>	N	NE	DS

<i>Betula alba</i>	EXO	NE	DS	<i>Parthenocissus</i>	EXO	NE	DS
<i>Buxus sempervirens</i>	N	NE	DS	<i>quinqifolia</i>			
<i>Callistemon citrinus</i>	EXO	NE	DS	<i>Philadelphus coronarius</i>	EXO	NE	DS
<i>Carpinus spp.</i>	N	NE	DS	<i>Phormium tenax 'Atropurpurea'</i>	EXO	NE	NSD
<i>Cercis siliquastrum</i>	N	NE	DS	<i>Phormium tenax 'Variegata'</i>	EXO	NE	NSD
<i>Cortaderia selloana</i>	EXO	NE	DS	<i>Photinia frasseri</i>	EXO	NE	NSD
<i>Cotoneaster frasseri</i>	EXO	NE	DS	<i>Photinia serrulata 'red Robin'</i>	EXO	NE	DS
<i>Cupressocypariss leylandi</i>	EXO	NE	DS	<i>Picea punges 'Glauca'</i>	EXO	NE	DS
<i>Euonymus japonica 'aurea'</i>	EXO	NE	DS	<i>Pinus mugo</i>	EXO	NE	DS
<i>Euryops pectinatus</i>	EXO	NE	DS	<i>Pittosporum tobira</i>	EXO	NE	DS
<i>Ginkgo biloba</i>	EXO	NE	DS	<i>Prunus cerasifera</i>	EXO	NE	DS
<i>Grevillea juniperina</i>	EXO	NE	DS	<i>Pyracantha coccinea</i>	EXO	NE	DS
<i>Hebe veronica</i>	EXO	NE	DS	<i>Pyracantha coccinea 'Nana'</i>	N	NE	DS
<i>Hedera helix</i>	N	NE	DS	<i>Rhododendron obtusum</i>	EXO	NE	NSD
<i>Hydrangea spp.</i>	EXO	NE	DS	<i>Rosa meiland</i>	EXO	NE	DS
<i>Juniperus horizontalis</i>	EXO	NE	DS	<i>Rosmarinus officinalis</i>	EXO	NE	DS
<i>Lagerstroemia indica</i>	EXO	NE	DS	<i>Salix babylonica</i>	EXO	NE	NSD
<i>Laurus nobilis</i>	N	NE	DS	<i>Thuja occidentalis 'smaragd'</i>	EXO	NE	NSD
<i>Lavandula officinalis</i>	EXO	NE	DS	<i>Viburnum lucidum</i>	EXO	NE	DS
<i>Ligustrum vulgare</i>	N	NE	DS	<i>Viburnum tinus</i>	N	NE	DS
				<i>Wisteria sinensis</i>	EXO	NE	NSD

N/EXO: Natural/ Exotic, Exotic: Exo, N: Natural, ES: Endemic Status E:Endemic, NE: Non-endemic, DRP: Drought Resistance Properties, DS: Drought Suitable, NSD: Not suitable for drought

The classification of the plants in the study area according to their water requirements (low, medium, high) is given in Table 7, and the views of the appropriate plant selection criterion findings are given in Fig. 4.

Table 7. Classification of Plants According to Water Requirements (Low, Medium, High) (By using these resources [1, 16, 18, 42, 43, 44, 45, 46, 47]).

Low
<i>Albizia julibrissin</i> , <i>Berberis thunbergii</i> ‘atropurnurea’, <i>Callistemon citrinus</i> , <i>Cortaderia selloana</i> , <i>Euryops pectinatus</i> , <i>Juniperus horizontalis</i> , <i>Laurus nobilis</i> , <i>Ligustrum vulgare</i> , <i>Mahonia aquifolium</i> , <i>Quercus ilex</i> , <i>Nerium oleander</i> , <i>Parthenocissus quinquefolia</i> , <i>Pyracantha coccinea</i> ‘Nana’, <i>Rosmarinus officinalis</i> , <i>Viburnum tinus</i> ,
Medium
<i>Abies nordamanniana</i> , <i>Abelia grandiflora</i> , <i>Acer platanoides</i> ‘Chrimson King’, <i>Aesculus hippocastanum</i> , <i>Aesculus carnea</i> ‘Briotii’, <i>Aucuba japonica</i> , <i>Betula alba</i> , <i>Buxus sempervirens</i> , <i>Carpinus</i> spp. <i>Cercis siliquastrum</i> , <i>Cupressocyparis leylandii</i> , <i>Euonymus japonica</i> ‘aurea’, <i>Ginkgo biloba</i> , <i>Grevillea juniperina</i> , <i>Hebe veronica</i> , <i>Hedera helix</i> , <i>Hydrangea</i> spp., <i>Lagerstroemia indica</i> , <i>Lavandula officinalis</i> , <i>Liriodendron tulipifera</i> , <i>Magnolia</i> spp., <i>Morus alba</i> ‘Pendula’, <i>Quercus robur</i> , <i>Quercus rubra</i> , <i>Nandina domestica</i> ‘Nana’, <i>Philadelphus coronarius</i> , <i>Photinia fraseri</i> , <i>Photinia serrulata</i> ‘red Robin’, <i>Picea pungens</i> ‘Glauca’, <i>Pinus mugo</i> , <i>Pittosporum tobira</i> , <i>Prunus cerasifera</i> , <i>Pyracantha coccinea</i> , <i>Rosa meilland</i> , <i>Viburnum lucidum</i> ,
High
<i>Phormium tenax</i> ‘Atropurpurea’, <i>Phormium tenax</i> ‘Variegata’, <i>Photinia fraseri</i> , <i>Rhododendron obtusum</i> , <i>Salix babylonica</i> , <i>Thuja occidentalis</i> ‘smaragd’, <i>Wisteria sinensis</i>



Fig. 4. Views of Appropriate Plant Selection Criteria Findings (Original, 2022)

Findings on Limiting Grass to Appropriate and Functional Areas

Grass species consume more water than other plant species. Therefore, grass areas should be preferred as little as possible, and if a solution from different types can be found, they should be preferred instead of grass areas. If grass areas are to be used, drought-resistant species suitable for the ecology of the region should be selected and applied in one piece [9]. When the findings regarding the limitation of grass to suitable and functional areas in Table 8 are examined, it has been determined that 6 of the 8 criteria are suitable for xeric landscape design principles, 1 of them is partially suitable and 1 criterion is not suitable for xeric landscape design.

Table 8. Evaluation Table for Criteria for Limiting Grass to Suitable and Functional Areas

Basic Principles	Criteria	E	K	H
D-Limiting The Grass To Suitable and Functional Areas	1 Grass was not used in sloping areas	X		
	2 There are large grass areas	X		
	3 Grass areas are applied in one piece or in connection with each other	X		
	4 Grass species are suitable for the climatic characteristics of the city	X		
	5 Grass area is resistant to arid conditions		X	
	6 Artificial grass is used in the area			X
	7 The grass area is resistant to pressure and wear	X		
	8 Grass was not used in sloping areas			X

E: Yes K: Partially H: No

16.500 m² of the 20.540 m² area consists of green areas. Among the green areas, grass areas have the largest size. Grass areas are the areas where water is used the most in landscape design, and in xeric landscape design, which aims to minimize water use, it is desired to include grass areas as little as possible. As a result of the examinations carried out in the area, studies were not carried out to reduce the grass areas, but the grass areas were applied in a single piece and connected to benefit from irrigation more effectively. When creating grass areas, natural species were chosen instead of artificial grass and were used throughout the park, especially in the sloping areas. The grasses used are *Festuca arundinacea*, *Festuca rubra rubra*, *Festuca rubra trichophylla*, *Lolium perene*, and *poa pratensis* species. When the properties of the grasses are examined, the grasses used are suitable for the climatic characteristics of the city. While *Festuca arundinacea*, *Festuca rubra rubra*, *Festuca rubra trichophylla* varieties were determined to be suitable for drought conditions and printing, *Lolium perene* and *poa pratensis* species are not suitable for drought and printing. The views of the findings of the criterion of limiting the grass to suitable and functional areas are given in Fig. 5.



Fig. 5. Views of the Findings of the Criterion of Limiting Grass to Appropriate and Functional Areas (Original 2022 and Original 2023)

Findings on Effective Irrigation

Irrigation methods are very important to effectively benefit from irrigation in landscape designs. The most appropriate irrigation method should be determined by experts according to the purpose of use of the area, its size and the arrangement to be made [48]. When the findings regarding the suitability of the effective irrigation criteria given in Table 9 for drought are examined, 5 out of 8 criteria are suitable for xeric landscapes and 3 of them are not suitable for xeric landscapes.

Table 9. Effective Irrigation Criteria Evaluation Table

Basic Principles	Criteria	E	K	H
E- Effective Irrigation	1 Drip irrigation system is used	X		
	2 Grass areas are irrigated with a low-pressure sprinkler irrigation system	X		
	3 Irrigation system is connected to automation	X		
	4 Irrigation hours are after sunset or early in the morning	X		
	5 Irrigation heads are placed in accordance with water saving	X		

6	Water resources are used effectively (rain water, natural water source etc.)	X
7	Irrigation water is obtained from wastewater	X
8	Sprinklers of the irrigation system are placed considering the prevailing wind direction	X
E: Yes K: Partially H: No		

While a drip irrigation system is used to irrigate some plants (shrubs, seasonal flowers) in the area, a low-pressure sprinkler irrigation system is used for the irrigation of grass areas. Irrigation is carried out between 00:30 and 07:00 during the quiet hours of the park, depending on an automation system and by placing the irrigation heads following water saving. Mains water is used for irrigation, rainwater, natural water sources, etc. are not used in addition to the mains water, and there is no structure or facility to ensure the reuse of wastewater. Fig. 6 shows the views of the findings of the efficient irrigation criterion.



Fig. 6. Views of Effective Irrigation Criteria Findings
(Original 2022 and Original 2023)

Findings on the Use of Mulch

The use of mulch has many important tasks such as maintaining the moisture of the soil, preventing scabbing on the soil surface, facilitating the access of water to the roots, ensuring weed control, preventing diseases caused by soil, acting as insulation in the soil and reducing the amount of irrigation by reducing the amount of water lost by evaporation [49]. When the findings regarding the use of mulch given in Table 10 were examined, it was determined that 1 criterion was suitable for xeric landscape design criteria and 1 criterion was not suitable for xeric landscape design criteria.

Table 10. Mulch Use Criteria Evaluation Table

Basic Principles		Criteria	E	K	H
F- Use of Mulch	1	Organic mulch was used (plant bark, leaves, etc.)			X
	2	Inorganic mulch was used (stone, rock, gravel, plastic sheet, etc.)	X		

E: Yes K: Partially H: No

Organic mulches have many benefits such as meeting the fertilizer needs of plants by decomposing, improving soil texture, and providing natural drainage. Organic mulches should be preferred in xeric landscape design and inorganic mulches should not be used whenever possible. It was observed that inorganic mulches containing stones and gravel were used as mulching elements in the area, but the inorganic materials used were mostly used to add visuality (Fig. 7).



Fig. 7. Views of Mulch Use Criteria Findings (Original, 2022)

Findings on Appropriate Care

Plants are one of the most important elements of landscape design. Appropriate and timely care for plants in landscape design, fertilization, pest control, weed control removal of plant waste, and early precautions against any diseases that may occur in plants are extremely important for the continuity and visual quality of the design. It was determined that 3 of the 4 criteria of the appropriate care principle given in Table 11 were made per the xeric landscape design, and 1 of them was partially suitable.

Table 11. Appropriate Care Criteria Evaluation Table

Basic Principles		Criteria	E	K	H
G- Appropriate Care	1	Correct pruning has been carried out	X		
	2	Regular weed control is carried out		X	
	3	Regular fertilization is done	X		
	4	Fighting against diseases and pests is carried out	X		

E: Yes K: Partially H: No

While this area was used as an institutional garden, it was reorganized and opened to public use in April 2021. Existing and newly planted plants were pruned in a way that would provide shading, preserve their form, and provide aesthetic views. Fertilizer has

been applied to the plants at the planting stage and will be re-applied when necessary. Since it is a new park, no diseases or pests have been detected. Necessary intervention will be carried out when detected. However, it has been observed that weed control is not carried out in some areas even though it is needed (Fig. 8).



Fig. 8. Views of Appropriate Care Criteria Findings (Original, 2022)

Results and Recommendations

As a result of global climate changes, water scarcity and drought in the world and in Turkey are increasing day by day. As today's generations, precautions must be taken for the water needs of future generations. A large part of drinking water is used in irrigation water, and one of the measures taken to reduce this use is xeric landscaping practices. This study was carried out to evaluate "Tokat City Park" in terms of xeric landscape design approaches. The following results were obtained in this study.

To measure the suitability of Tokat City Park for xeric landscape design, criteria for the 7 principles of xeric landscape were determined and these criteria were answered as Yes-Partly-No to determine the xeric landscape feature of the study area. 10 criteria for the planning and projecting principle of xeric landscape design, 4 criteria for the principle of soil preparation, 9 criteria for the principle of appropriate plant selection, 8 criteria for the principle of limiting the grass to suitable and functional areas, 8 criteria for the principle of effective irrigation, 2 criteria for the principle of mulch use and 2 criteria for the principle of appropriate planting, 4 criteria have been determined for the appropriate care principle.

It was determined that 6 of the 10 criteria belonging to the planning and projecting principle were made following the Xeric landscape design, 1 of them was partially suitable for the Xeric landscape design, and 3 of them were not made in accordance with the Xeric landscape design. The regulations on this issue must necessarily be taken into account during the planning and project design process, that is, before the application process. The situation of the study area that does not comply with the planning and project principles is that there is no terracing to prevent water loss and the plants are not separated according to their water needs. This area is not at a level that can be made suitable in terms of this principle. It is possible to make special areas for collecting rainwater and to make the hard floors permeable to drought. To fulfill these criteria, special areas for rainwater collection should be built in the area and water-permeable floors should be used instead of water impermeable hard floors. In addition, since the plants in the area were

not previously divided into zones according to water requirements, attention was not paid to dividing them into zones when landscaping was done.

This area was found suitable for xeric landscape design in terms of 3 of the 4 criteria created for the soil preparation principle but was not found suitable in terms of 1 criterion since soil analysis was not carried out before the project. Incomplete soil analysis means more water use, more or less plant nutrients than the plant needs, and faulty disease and pest control.

9 criteria were created for suitable plant selection, 5 of them were determined to be suitable for xeric landscape design, 2 of them were partially suitable and 2 of them were not suitable for xeric landscape design criteria. When we look at the criteria of the principle of appropriate plant selection, which are not suitable for xeric landscape design, it is seen that the existing plants are not selected from species that are completely suitable for xeric landscape design. However, in new regulations, species suitable for drought should be selected and plant planting should be done considering these criteria. In this area, trees and evergreen plants were generally used for measurement. Trees, shrubs, and herbaceous plants with colorful leaves and flowers should be used to reduce the gloom of the area and increase the visual landscape. For this purpose, the plants given in Table 12 should be used.

Table 12. Recommended Plants for Tokat City Park (By using these resources [1, 50, 51, 52, 53, 54,55, 56, 57, 58, 59, 60, 61]).

		
<i>Acacia dealbata</i>	<i>Cotinus coggygia Scop.</i>	<i>Gaura lindheimeri</i>
Water requirement: Less	Water requirement: Less	Water requirement: Low/Medium
		
<i>Weigela florida (Bunge) A. DC.</i>	<i>Caesalpinia pulcherrima</i>	<i>Muhlenbergia capillaris</i>
Water requirement: Medium	Water requirement: Less	Water requirement: Less
		
<i>Rosa banksiae</i>	<i>Melaleuca alternifolia</i>	<i>Bauhinia variegata</i>
Water requirement: Less	Water requirement: Less	Water requirement: Medium

8 criteria were created to limit the grass to suitable and functional areas, 6 of them were found to be suitable for xeric landscape design principles, 1 was partially suitable and 1 criterion was not found suitable for xeric landscaping. When the principle of limiting grass to suitable and functional areas is evaluated for its suitability for drought, it is desired to give as little space as possible to grass areas, which are among the areas that use the most water in xeric landscape design. As a result of the examinations made in the area, it was determined that the principle of reducing the grass areas was not applied, on the contrary, grass areas are located in excess throughout the park. To reduce grass areas, small gardens consisting of xeric plants should be made in some areas where grass areas are located and made suitable for drought. To make the criterion “grass area is resistant to arid conditions”, which is another criterion, suitable for arid landscape design, grass areas should be re-created from other drought-suitable species instead of non-drought-suitable grass species (*Lolium perene* and *poa pratensis* species).

It has been determined that 5 of the 8 criteria created for the effective irrigation principle are suitable for xeric landscapes and 3 of them are not suitable for xeric landscaping. To meet the criterion of effective irrigation principle, which is not suitable for drought, water resources are used effectively (rainwater, natural water source, etc.), the use of network water should be minimized by developing a rainwater collection area that can be built in the area in addition to the mains water to irrigate the area, or by developing systems to use Yeşilirmak and Behzat Creek water near the area for irrigation. Studies should also be carried out for structures or facilities that will enable the reuse of wastewater.

While 1 of the 2 criteria of the mulch use principle was found to be suitable for xeric landscape design, 1 was not found suitable. To make the criterion "inorganic mulch is used", which is one of the criteria of the principle of mulch use that is not suitable for drought, the areas where inorganic mulch is used should be regulated and organic mulches should be used instead of inorganic mulches.

It was observed that 3 of the 4 criteria of the appropriate care principle were made under xeric landscape design, and 1 was partially suitable. To bring the criterion of “regular weed control is being carried out”, which is the partially unsuitable criterion of the appropriate care principle for drought, following the arid landscape design, the places where weed control is not carried out should be intervened by authorized persons. The image of the area that is in disrepair and impairs visual quality should be corrected.

As a result, in terms of 7 principles and 45 criteria evaluated, it has been determined that 29 criteria of Tokat City Park are suitable for drought, 3 criteria are partially suitable and can be made suitable with new arrangements and 13 criteria are not suitable for xeric landscape design. The most important problem here is the use of the right plant material. Although Tokat is very rich in terms of plant life, 86% of the existing plant life in the area is selected from exotic species. Only 7 of the exotic species are not suitable for drought, and 42 of them are suitable for drought. However, this choice is the result of the plants being chosen by chance, not for Xeric landscape design. Eliminating the negativities requires that studies on this subject be carried out by experts who are knowledgeable about ecological design. For this reason, experts must be employed in relevant institutions.

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