



Investigation of Selcuk University Alaeddin Keykubat Campus in Terms of Xeriscape Design

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ABSTRACT

Drought and thirst are among the most important problems in today's world where water resources are depleted more rapidly due to global warming and climate change. The use of plant species with high water needs in landscaping causes an increase in the need for irrigation and more water consumption. For this reason, the need for xeriscape design in landscape areas has increased in recent years. The aim of this study is to examine and evaluate the xeriscape landscaping in Selcuk University Alaeddin Keykubat Campus in line with the xeriscape principles. As a result of the examinations, it was determined that the xeriscape design areas in the campus were generally created in accordance with xeriscape principles.

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Introduction

The need for green space in urban settlement areas has emerged as a result of man's dependence on nature. Green areas have many functions, such as creating an aesthetic and healthy environment and reducing the effects of some gases “ will increase in direct proportion to the population in the future, the amount of water to be used in these areas will increase compared to today. For this reason, it is extremely important that the water required for irrigation of green areas is not met from mains water, but is made with water obtained through recycling, and the correct irrigation method is chosen in the field. Because it is obvious that our need for water will increase in the future (Şahin ve Güngör, 2008).

In recent years, drought caused by global warming has caused global climate changes. Excessive consumption resulting from rapid urbanization has reached unconscious levels, and this is one of the most important factors triggering drought (Bradley et al, 2012). Water is one of the important natural resources that is indispensable for living life, cannot be reproduced and has no alternative. In recent years, design approaches that use water effectively have been preferred in order to reduce water consumption, especially in landscaping in cities. One of these approaches is “Xeriscape Design”. Xeriscape design is generally

defined as a type of landscape design that adopts the principle of minimizing the use of water and protecting water resources and the environment (Sezen et al., 2018).

Xeriscape was derived from the Greek word ‘xeros’ meaning dry and ‘landscape’ (Sovocool and Morgan, 2005). The term “Xeriscape” was first used by the Colorado Xeriscape Council, which was established in Denver, Colorado, USA, in 1978, and continues to spread today with different interpretations (Çorbacı et al, 2011).

The first garden designed in line with xeriscape principles was designed in the 1970s. Located in a semi-arid region in Colorado, this garden was implemented as an exhibition area where vegetal areas were created using little or no water. This garden was designed around a non-classical plan, using similar but different materials. Thus, it has become an instructive garden on how to use water more effectively. This garden, opened in 1980, consists of more than five thousand plants of ninety different species. Most of these plants are local plants of the region they belong to (Yazgan et al, 2010).

The main purpose of xeriscape design is to protect water resources by minimizing water use. Areas designed with xeriscape do not need regular maintenance. Since regular maintenance is not required, the sustainability of

these areas is easily ensured. Additionally, by minimizing water use, water resources are used effectively. It is very important for xeriscape design that the plants used in the design are drought resistant (Çetin, 2016).

The maintenance costs of gardens designed according to xeriscape design are less than gardens designed with other methods. Large grass areas are not included in the designed areas. These designs are often used for many years. In addition, xeriscape design saves time as it is applied to the area in a shorter time than other landscape design applications. Efficient use of water and long life of the design are among the most important features of xeriscape design (Taner, 2010). In addition, xeriscape design approaches not only reduce water use by 50%, but also demonstrate an approach that is compatible with the environment, requires little use of chemicals, and requires low maintenance and cost. Instead of completely changing the existing design, it is based on how to evaluate the current situation for the effective use of water. Xeriscape planning provides many economic and ecological benefits. It is expected to provide drought-resistant herbal solutions by reducing water use (Becca Rodomsky-Bish, 2015; Pouya et al, 2016).

Principles of Xeriscape

In addition to saving water, xeriscape principles contribute to nature with their nature-friendly approach, and by reducing water consumption, they contribute to fresh water resources lost as a result of global warming in the long term (Metin ve Koçan, 2020). There are seven xeriscape principles (Welsh et al., 2007):

- Planning and design
- Soil analysis and preparation
- Practical turf areas
- Appropriate plant selection
- Efficient irrigation
- Use of mulches
- Appropriate maintenance

Planning and Design

Planning and design stages are very important for successful xeriscape application. Proper planning saves time, money and prevents work from being done twice (Çorbacı et al., 2011). In addition, determining the direction of the design and creating a framework that suits the project goals is also extremely important (Akay and Polat, 2023).

Creating a water-efficient landscape starts with a well-thought-out landscape design. The outline of the garden must first be drawn by determining the locations of buildings, trees, bushes and grass areas. Next, consideration should be given to how various areas of the garden will be used, how the garden will look, the amount of maintenance planned and the budget. In addition, the areas of the landscape that need the most water must be determined. The goal of planning is to design a landscape that will have the desired appearance and function while conserving water. Landscape design can also be implemented gradually over several years (Welsh et al., 2007).

Soil Analysis and Preparation

First of all, soil analysis should be done. Analysis results tell you what type and amount of fertilizer the soil needs and whether organic matter is required. Most soils benefit greatly from organic matter. Adding organic matter to the soil of flower beds and shrubs makes plants healthier. Organic matter also helps soil absorb and store water. It is not necessary to add organic matter for trees (Welsh et al., 2007).

Soil analysis is extremely important for a successful xeriscape design. Soil analysis plays an important role in determining the plant species to be used in the area. It is necessary to improve the soil before installing the irrigation and drainage system and planting plants. Soil reclamation forms the basis of a good landscaping work. In a reclaimed soil, the water retention capacity of the soil increases, it becomes easier for plants to absorb water, and sufficient air spaces are formed to allow plant roots to get enough air (Çorbacı et al., 2011).

Practical Turf Areas

When designing the landscape, it should not be forgotten that grasses need more water and care than other plants. To preserve water, the amount of lawns should be reduced by incorporating patios, terraces, shrubs and ground cover plants into the landscape design. It is also necessary to consider the ease of watering lawn areas. Long and narrow, small or oddly shaped areas are difficult to irrigate efficiently. Lawns should be confined to blocky, square-like areas that are easier to maintain. Ground cover plants can also be used as alternative plants instead of grass (Welsh et al., 2007).

Appropriate Plant Selection

Trees, shrubs and ground cover plants suitable for the soil and climate of the region where xeriscape design will be made should be selected. One of the best ways to preserve water is to choose grass species that are suitable for the region where xeriscape design will be applied and have low water demand (Welsh et al., 2007).

In xeriscape design studies, the selection of plant species is very important. Imported species that will be chosen instead of plant species belonging to the local habitat will require more water than endemic and locally suitable species, so the use of such plants will result in the use of additional water and fertilizer (Wade et al., 2010).

Appropriate plant selection means choosing plants that not only match the design, but also suit the planting site and local environment. Plants should be selected according to the soil type and light level of the area. The plants you choose should be able to adapt to local fluctuations in temperature and soil moisture (Wade et al., 2010).

Efficient Irrigation

Huge amounts of water are supplied to lawns and gardens, but most of the water is never absorbed by the plants. Some of the water flows away because it is given too quickly, and some of it evaporates from the exposed, unmulched soil. However, the biggest water waste comes from watering too frequently. When too much water is supplied to the land, nutrients can leach from plant roots deep into the soil and possibly contaminate groundwater. In addition, fertilizers and pesticides are transported to

streams and lakes in this way, causing pollution. These problems can be easily eliminated with correct irrigation techniques (Welsh et al., 2007).

The goal of any irrigation system is to provide plants with sufficient water without wasting it. By installing an irrigation system, lawns, ground cover plants, shrubs and trees can be watered individually and more frequently. Sprinkler and drip irrigation systems are used together to save water in the landscape. If a permanent sprinkler system is used, sprinkler heads must be positioned correctly to prevent watering sidewalks and driveways. In addition, it is essential to adjust the sprinkler heads to spray large water droplets rather than those that evaporate quickly and can be carried away by the wind. Drip irrigation system is more efficient and beneficial for plants than sprinkler irrigation system. Drip irrigation systems are also safer for landscapes in areas where water quality is poor. Drip irrigation slowly applies water to the soil. Water flows under low pressure through emitters, sprinklers, or spray heads placed throughout each facility. There is very little chance that water applied via drip irrigation will be wasted through evaporation or runoff (Welsh et al., 2007).

Use of Mulches

Mulch is a layer of non-living material that covers the soil surface around plants. Mulches can be of organic materials, such as pine bark, compost, and sawdust, or inorganic materials, such as lava rock, limestone, or permeable plastic. Mulch should be used wherever possible. Good mulching saves water by significantly reducing moisture evaporation from the soil. It also reduces weeds, prevents soil compaction and maintains soil temperature (Welsh et al., 2007).

Mulch up to 5-7.5 cm thick can be used under trees and shrubs. If this layer is thicker than necessary, plant roots may be damaged. Fine-textured organic mulches retain water better than coarse-textured mulches (Çorbacı et al., 2011).

Appropriate Maintenance

Mowing lawns at the appropriate height saves water because it encourages root systems to grow deeper and be more water efficient. Fertilizing the lawn at the right time and in the right amount saves time, effort and money by reducing mowing and watering. It is necessary to fertilize the lawn once in spring and once in autumn. While slow-release nitrogen form fertilizer should be used in spring application, fast-release nitrogen form fertilizer should be used in autumn application. For efficient operation, the irrigation system should be checked and maintained periodically. Insect and disease controls should be carried out and weeds should be eliminated. Maintenance costs for a well-designed landscape using xeriscape principles can be reduced by up to 50% by mowing less frequently, mulching once a year, eliminating incompatible plants that need a lot of water, and efficient irrigation methods (Welsh et al., 2007).

Maintenance works, as in all other landscape areas, are extremely important in terms of preserving the features of the area and ensuring its continuity. Depending on climatic factors and the characteristics of the plants used, maintenance work such as pruning, fertilization, weeding, disease and pest control should be carried out on time and

in accordance with the technique, and attention should be paid to the irrigation system, in order to preserve and increase the quality of the xeriscape design (Çorbacı et al., 2011).

Materials and Methods

The main material of the study consists of all xeriscape design areas within Selçuk University Alaeddin Keykubat Campus, located in Selçuklu district of Konya province. These areas are: Rectorate garden, Museum garden, Faculty of Agriculture garden and areas with xeriscape designs covering certain parts of Celal Bayar Street.

The aim of this study is to examine and evaluate the xeriscape designs in Selçuk University Alaeddin Keykubat Campus in line with xeriscape principles. For this purpose, first the study areas were determined. Then, a literature review was made and the study areas were visited and examined. Photographs were obtained from the areas. The suitability of the areas for xeriscape design was evaluated in the light of literature sources. As a result of the evaluations, conclusions and recommendations are given.

Results and Discussion

Examination of Xeriscape Design in the Rectorate Garden in Terms of Xeriscape Principles

The Rectorate building was built on November 2, 2017. It is located on Celal Bayar Street of Alaeddin Keykubat Campus.

When the xeriscape designs applied in the Rectorate garden are examined according to xeriscape principles, it is seen that appropriate planning and design has been made in the area. The necessary soil reclamation for the xeriscape design in the garden was done beforehand and appropriate plant species were used in the design. Water is given to the plants using the drip irrigation method and in this way the water needs of the plants are met. Effective irrigation is done using the drip irrigation method.

White dolomite stones, pumice stones and pebbles were used instead of grass plants in the xeriscape areas in the Rectorate garden (Figure 1). Therefore, it can be said that these areas comply with the principle of sustainable grass areas. In this design, thanks to the sulzer fabric base cover used under the stones, the soil is prevented from losing moisture and the temperature of the soil is maintained. Mulching was done with this fabric. Due to the tearing of the sulzer fabric base cover used under the pebbles, soil moisture emerged and weeds grew in the area. Therefore, it can be said that mulching is not fully done in this area.

Using plant species that grow naturally in the region in xeriscape design ensures that the plant's maintenance needs such as watering and fertilization are low. Plant species suitable for soil and climate conditions were selected in the Rectorate garden. In this respect, it can be said that the maintenance need of the area is low. However, in a part of the xeriscape area, the text "Selçuk" was written with boxwood (*Buxus sempervirens*) plants (Figure 2). The fact that this plant always needs pruning and that the area is invaded by weeds due to the worn-out mulch material used in this area shows that the principle of appropriate and sustainable care is not fully fulfilled.



Figure 1. Xeriscape design applied at the entrance of the Rectorate building (Original, 2022).



Figure 2. Xeriscape design applied on the garden of the Rectorate building (Original, 2022).



Figure 3. Xeriscape design applied in the front garden of the museum building (Original, 2022).



Figure 4. Xeriscape design applied in the front garden of the museum building (Original, 2022).

Examination of Xeriscape Design in the Museum Garden in Terms of Xeriscape Principles

The museum was opened in 2016. It is located on Celal Bayar Street of Alaeddin Keykubat Campus.

When the xeriscape designs applied in the museum garden are examined according to xeriscape principles, it is seen that appropriate planning and design has been made in the area. The necessary soil reclamation for the xeriscape design in the garden was done beforehand and appropriate plant species were used in the design. Water is given to the plants using the drip irrigation method and in this way the water needs of the plants are met. Effective irrigation is done using the drip irrigation method (Figure 3).

White dolomite stones were used in some of the xeriscape area in the museum garden, and in some parts, ground cover plants (especially *Sedum* species) were used instead of grass plants (Figure 4). Therefore, it can be said that these areas comply with the principle of sustainable grass areas. It was observed that the sulzer fabric base cover used under the stones in this design was torn. Thus, soil moisture emerged and weeds grew in the area, so the mulching process could not be done correctly.

Maintenance work is required to protect the area and ensure continuity, as in all other landscape areas. The aim of the principle of appropriate and sustainable maintenance is to carry out maintenance activities such as irrigation,

pruning, fertilization and weeding in a complete and sustainable manner. The inadequate development and drying of the plants used in the area, the bareness in the soil and the deterioration in the design indicate that the maintenance work is not sufficient.

Examination of Xeriscape Design in Agricultural Faculty Garden in Terms of Xeriscape Principles

Faculty of Agriculture was opened on July 20, 1982. It moved to its current building in 1992. It is located on Suleyman Nazif Street of Alaeddin Keykubat Campus.

When the xeriscape designs applied in the faculty garden are examined according to xeriscape principles, it is seen that appropriate planning and design has been made in the area. The necessary soil reclamation for the xeriscape design in the garden was done beforehand and appropriate plant species were used in the design. Water is given to the plants using the drip irrigation method and in this way the water needs of the plants are met. Effective irrigation is done using the drip irrigation method.

Pebbles were used in some of the xeriscape area in the faculty garden, and ground cover plants (especially *Berberis thunbergii* "Atropurpurea" and *Cerastium tomentosum*) were used instead of grass plants in some parts (Figure 5 and 6).



Figure 5. Xeriscape design applied in the front garden of the Faculty of Agriculture (Original, 2022).



Figure 6. Xeriscape design applied in the front garden of the Faculty of Agriculture (Original, 2022)



Figure 7. Xeriscape design applied on Celal Bayar street (Original, 2022).



Figure 8. Xeriscape design applied on Celal Bayar street (Original, 2022).

Therefore, it can be said that these areas comply with the principle of sustainable grass areas. In this design, thanks to the sulzer fabric base cover used under the stones, the soil is prevented from losing moisture and the temperature of the soil is maintained. Mulching was done with this fabric. Using plant species that grow naturally in the region in xeriscape design ensures that the plant's maintenance needs such as watering and fertilization are low. Plant species suitable for soil and climate conditions were selected in the faculty garden. In this respect, it can be said that the maintenance need of the area is low. The fact that there is no need for pruning since no grass is used in the xeriscape area, the area is mulched and there are no weeds shows the existence of the principle of appropriate and sustainable maintenance.

Examination of Xeriscape Design in Celal Bayar Street in Terms of Xeriscape Principles

When the xeriscape designs applied on Celal Bayar street are examined according to xeriscape principles, it is seen that appropriate planning and design has been made in the area. The necessary soil reclamation for the xeriscape design in the garden was done beforehand and appropriate plant species were used in the design. Water is given to the plants using the drip irrigation method and in this way the water needs of the plants are met. Effective irrigation is done using the drip irrigation method. In the xeriscape areas on Celal Bayar street, pebbles and ground cover plants (especially *Berberis thunbergii* "Atropurea") were used instead of grass plants

(Figure 7). Therefore, it can be said that these areas comply with the principle of sustainable grass areas. In this design, thanks to the sulzer fabric base cover used under the stones, the soil is prevented from losing moisture and the temperature of the soil is maintained. Mulching was done with this fabric (Figure 8).

Using plant species that grow naturally in the region in xeriscape design ensures that the plant's maintenance needs such as watering and fertilization are low. Plant species suitable for soil and climate conditions were selected in the Celal Bayar street. In this respect, it can be said that the maintenance need of the area is low. The fact that there is no need for pruning in these areas since grass is not used, the area is mulched and there are no weeds indicate the existence of the principle of appropriate and sustainable maintenance.

Conclusion and Recommendations

Conclusion

In the table above, xeriscape designs are evaluated whether they comply with xeriscape principles. It has been determined that the use of appropriate mulch and sustainable maintenance efforts are not sufficient in the xeriscape designs applied in the Rectorate and Museum gardens, and other xeriscape principles are sufficient. In xeriscape designs applied in other areas, it has been determined that all xeriscape principles are sufficient (Table 1).

Table 1. Evaluation of Xeriscape Designs according to Xeriscape Principles

Xeriscape Principles	Rectorate Garden	Museum Garden	Agricultural Faculty Garden	Celal Bayar Street
1. Planning and design	√	√	√	√
2. Soil analysis and preparation	√	√	√	√
3. Practical turf areas	√	√	√	√
4. Appropriate plant selection	√	√	√	√
5. Efficient irrigation	√	√	√	√
6. Use of mulches	X	X	√	√
7. Appropriate maintenance	X	X	√	√

Recommendations

Since a large part of Turkey has semi-arid climate characteristics, it has become necessary to take some precautions against changing climate conditions and increasing drought. It is important to use water economically and protect water resources. Drought is considered one of the most risky disasters for humanity among natural disasters. The availability of water, a natural resource that has no alternative, is decreasing day by day. When the climate data of Konya province is examined, it is seen that Konya has an arid climate. For this reason, it is obvious that especially xeriscape designs should be at the forefront in landscape design studies to be carried out throughout Konya province.

Recommendations for the study areas are as follows: It was observed that there were weeds in the area because the sulzer fabric base cover used in the xeriscape design applied in the Rectorate garden was torn. This base cover needs to be replaced. In addition, plant species that will need less pruning should be determined and these plants should be included in the area.

The bare soil appearance resulting from the drying of the plants used in the xeriscape design applied in the museum garden and the wear and tear of the plants due to lack of care negatively affects the design. To cover the appearance of bare soil, ground cover plants suitable for soil and climate conditions can be used in the area. In addition, the pipes in the drip irrigation system used to irrigate areas should be hidden as they affect the aesthetic appearance. The sulzer fabric base cover used for mulching should be replaced because it is torn.

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