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Water Efficient Use for Sustainability of Water Resources in Urban Areas: Xeriscape

Kentsel Alanlarda Su Kaynaklarının Sürdürülebilirliği İçin Suyun Etkin Kullanımı: Kurakçıl Peyzaj Düzenleme

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ÖZ:

Tüm dünyadaki su kaynakları, iklim değişikliği, küresel ısınma, yanlış arazi kullanımları, kentlerde hızlı nüfus artışı gibi nedenlerden dolayı hızlı bir şekilde tükenmektedir. Su canlı yaşamı için vazgeçilemez, yeniden üretilemez, alternatifi olmayan en önemli doğal kaynaklardan birisidir. Son yıllarda özellikle kentlerde yapılan peyzaj düzenlemelerinde su tüketimi azaltabilmek için suyun etkin olarak kullanıldığı tasarım yaklaşımları tercih edilmektedir. Bu yaklaşımlardan birisi ise Kurakçıl Peyzaj Düzenlemeleri'dir.

Tüm Dünya'da "Xeriscape" olarak bilinen "Kurakçıl Peyzaj Düzenleme" genel olarak suyun en az düzeyde kullanılmasıyla, su kaynaklarının ve çevrenin korunmasını ilke edinen, özellikli peyzaj düzenleme olarak tanımlanmaktadır. Bu kavram ilk olarak 1981 yılında Denver Su Departmanı tarafından peyzaj düzenlemelerinde su kullanımına yönelik tasarrufun sağlanabilmesi amacıyla kuru anlamına gelen "xeros" ile peyzaj anlamına gelen "landscape" sözcüklerinin birleştirilmesi ile oluşturulmuştur.

Bu çalışmada; azalan su kaynaklarının etkin kullanımı için kentsel mekanlarda yapılan peyzaj tasarım anlayışında önemli değişikliklere gidilmesi, kentlerin sürdürülebilirliği için ekolojik yaklaşımlara ve bu bağlamda suyun etkin kullanımını sağlayan peyzaj tasarım ve uygulamalarından biri olan "Kurakçıl Peyzaj Düzenleme" anlayışına önem verilmesi gerektiği tartışılmış ve öneriler sunulmuştur.

Anahtar Kelimeler: Su, suyun etkin kullanımı, peyzaj, kurakçıl peyzaj düzenleme, kentsel alan

ABSTRACT:

Water resources all over the world are rapidly depleting due to climate change, global warming, misuse of land, rapid population growth in cities. Water is one of the most important natural resources that cannot be created for living. In

recent years, design approaches have been preferred in use to effectively of water to reduce of water consumption in landscape arrangements, especially in urban areas. One of these approaches is the Xeriscape.

The " Arid Landscaping " known all over the world as "Xeriscape" is a landscaping scheme that adopts the principle of protecting the water resources and the environment with minimum use of water. Xeriscape definition was first introduced by the Denver Water Department in order to provide savings for water use in landscaping in 1981. It was formed by combining the words "xeros" meaning dry and "landscape" meaning landscape.

As a result of the research, it has been suggested that importance should be attached to the concept of " Xeriscape" which provides efficient use of water in ecological approaches for urban sustainability in landscape designs made in urban areas.

Key Words: Water, effective use of water, landscape, xeriscape, urban areas

"Water Efficient Use for Sustainability of Water Resources in Urban Areas: Xeriscape"

INTRODUCTION:

Natural reserves are the elements thought not to be destroyed for the continuity of the life on the earth. However, today, increase in the environmental pollution and consumption habits of human beings in the parallel of rapid population increase, climate change resulting from global warming have so far caused decreases in the quality of natural reserves and rapid consumption of natural reserves. Depending on these factors, impairment in natural resources brings together serious problems. Especially contamination in water reserves may cause problems resulting in losses among plants in green areas in arid or semiarid regions (Çetinkale Demirkan and Akat, 2017)

Since the beginning of the 20th century, water consumption in the world has increased 6 times. Today 70% of total water consumption is for irrigation, 22% for industry and 8% for drinking and utility water. In developed countries, these rates are 30%, 59% and 11%, respectively, while in less developed countries they are 82%, 10% and 8%. In Turkey, these values are close to the world average and 72% of the water is consumed in agriculture, 18% in domestic use and 10% in industry sector (Karaca and Kuşvuran, 2012).

In the past, the main objective of landscape design applications was to improve the quality of the environment and restoration of the degraded environmental conditions, while in recent years, with the concerns due to the problems related to global warming and climate change and increase in the difficulty of providing water supply applications considering the rational use of water and design with resistant to drought are forefront (Baykan and Birişçi, 2013).

In our age, the problem of water shortage caused mainly by global warming and drought that negatively affect the whole world has unfavourable impacts on plant elements in the application of landscape architecture as it has on all living things. When such a condition is addressed by sustainable landscaping approach, it has brought about the Xeriscape (landscaping in drought) approach for the efficient water use to reduce the negative effects of drought in planning and implementation (Bayramoğlu, 2016).

"Landscape Design for the arid (regions/times) or "Xeriscape", in its most known name all over the world, is defined as a specific landscape design aimed at preserving water resources and environment with minimum water use. Xeriscape does not necessarily mean the zero water use. In previous years, in landscape architecture applications, improving the quality of the environment and restoration of the degraded environmental conditions have been the main objectives while in recent years, concerns related to global warming and climate change and efficient use of water and design and application with plant resistant to aridity have gained importance (Çorbacı et al., 2011).

Xeriscape was derived from the Greek word 'xeros' meaning dry and 'landscape' (Sovocool and Morgan 2005; Bayramoğlu, 2016). The term Xeriscape was first used in 1978 in Colorado state of the US. In this respect, approaches under the main title of "water-efficient landscape design", such as wise use of water, "little water use" and "natural landscape design" brought new concepts for traditional landscape design and planning (Çorbacı et al.., 2011). Such planning approach was used largely in 1980s in arid south States, Colorado and Florida (Barış, 2007; Gary, L.W. et al., 2009; Bayramoğlu, 2016).

1. 7 basic principles of Xeriscape

1.1. Appropriate planning and design,

1.2. Preparation and improvement of soil,

1.3. Preference of drought tolerant plants,

1.4. Reducing the rate of lawn,

1.5. Efficient irrigation,

1.6. Use of mulch,

1.7. Proper maintenance.

1.1. Appropriate planning and design

In order to achieve a water efficient landscape design, the most important stage is the planning and design. Rather than the preference of plant species to be used, physical and environmental conditions of the area should be analysed to understand and solve the present problems in the area. In the following stage, it is required to evaluate and prefer the design type considering the aims and scope, decide what plant species should be used and how to categorize the preferred plant species for their water consumption (Barış, 2007; Çetinkale Demirkan ve Akat, 2017).

In addition to the determination of landuse types in a landscape, a Xeriscape plan should categorize the landscape parts according to their water use. In this respect, place of the plants grouped considering their water demand can be determined. In Xeriscape works, plants are grouped and placed from the centre to outside for their water needs in three clear and special zones (Figure 1) (Çorbacı et al., 2011).

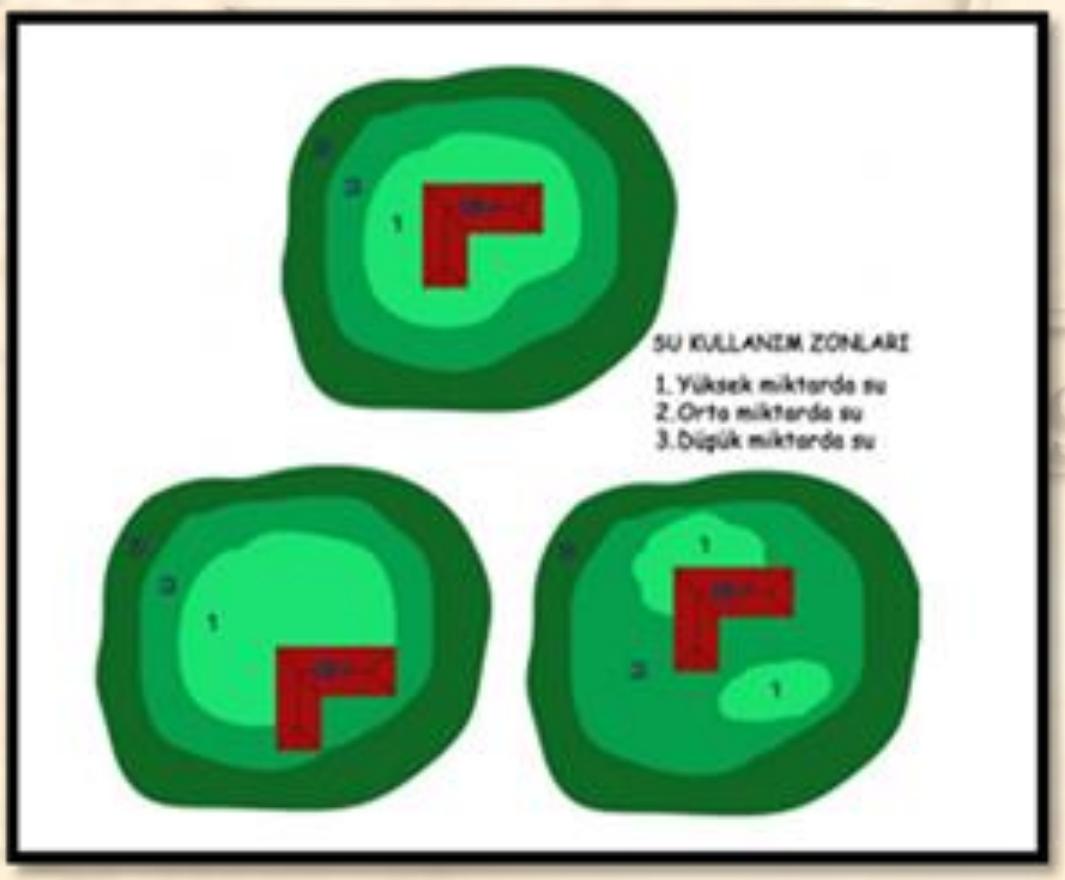

Figure 1. Water use zones (Çorbacı et al., 2011).

Water use zones according to Çorbacı et al. (2011);

Water use changing from moderate to high (Zone 1)

Low water use zone (Zone II)

Very low water use zones (Zone III)

Zone 1: In this zone, high water demanding plant species are used closely to the house. They are planted under formal pergolas. Generally, these zones may be turfs where grass species needing less water are used.

Zone 2: Plants used in this region require irrigation in addition to natural rainfall. In these areas, it is more suitable to use plants that require irrigation once a week or less.

Zone 3: The plants used in this zone require additional water very rarely after planting. This is the most suitable area for xeriscape (non-hydrophilic) and ground-covering plants. Natural plants and other varieties can take place in this area with very little additional water.

Orientation of the building in the zone can give information about the planting place of the plants (sunny or shadowy). For instance, plants planted at the points getting sun rays directly in the afternoon get drier more rapidly since they take in more water than those under shadow. It is suitable to place plants tolerant to aridity at such points.

1.2. Preparation and improvement of soil

In Xeriscape design, it is very important to determine the soil structure, which is the habitat of plants (Figure 2). Each soil type has its own unique texture, drainage, PH, nutritional value and fertilizer needs. For this reason, the area to be designed should be evaluated in terms of water retention capacity by soil analysis. As a result of the analysis, the organic materials of the soil should be improved and the nutrients needed for the plants should be provided. (Bayramoğlu, 2016).

Figure 2. Preparation and improvement of soil (URL-1)

1.3. Preference of drought tolerant plants

Especially the use of natural and drought tolerant (Figure 3) species suitable for the region is very important. Plants in the area to be planned should be selected among those species that require minimum additional water by considering climate, soil type and environmental conditions. Because the more natural the plant is, the more harmonious it is with the environment. For this reason it is necessary to use the natural species of the region, especially the arid plants (Bayramoğlu, 2016).

In Xeriscape type landscapes, plant material should be selected from species that require minimum additional irrigation. Although it is preferred feature that plants can grow using water only from rainfall 18-24 months after planting, all plant species can be used in xeriscape form (Çorbacı vd., 2011).

Figure 3. Drought tolerant plants (URL-2).

1.4. Reducing the rate of lawn

Since depending on the size of lawns in landscape architecture designs, they constitute the surfaces covering plants requiring the largest rate of maintenance and water, ground covering plants play an important role in water conservation in these areas (Figure 4). For this reason, it is necessary to use the lawns in the right places and for the right purposes in the Xeriscape designs. For instance, in the areas that need to be visually foregrounded, grass areas can be used as a whole in playgrounds or in recreation areas without fragmentation (Çetinkale Demirkan and Akat, 2017).

Figure 4. Reducing the rate of lawn (URL-3)

1.5. Efficient irrigation

The basic principle of landscapes based on rational water use is to make additional irrigation at minimum rates. For this reason drip irrigation is preferred in order to prevent excessive water loss by providing correct irrigation system and design (Figure 5). Irrigation should be made in the morning hours if the sprinkler system is used or drip irrigation can be run at any time of day. Drip irrigation can be defined as dropping water to the root zone of a plant (Çorbacı et al., 2011). The main purpose is to give water to the plant as much water as the plants need. For this reason, it is necessary to determine the amount of water consumption of each plant (Bayramoğlu, 2016).

The Xeriscape arrangement consists of mulch leaf layer, straw or organic matter. It keeps the moist content of the soil surface rich with organic matter and allows the water to penetrate into the water during irrigation. It is necessary to apply the materials used in a certain thickness and for a year (Bayramoğlu, 2016). It also makes it possible to maintain useful organisms and habitats for the plant in the soil.

Figure 5. Efficient irrigation (URL-4)

1.6. Use of mulch

The Xeriscape arrangement consists of mulch leaf layer, straw or organic matter (Figure 6). It keeps the moist content of the soil surface rich with organic matter and allows the water to penetrate into the water during irrigation. It is necessary to apply the materials used in a certain thickness and for a year (Bayramoğlu, 2016). It also makes it possible to maintain useful organisms and habitats for the plant in the soil.

Figure 6. Use of mulch (URL-5)

1.7. Proper maintenance

The proper maintenance work in the implemented Xeriscape arrangement is the most basic principle to maintain the continuity of the design (Figure 7). Weed control, pruning, fertilization, control of harmful organisms, and timely watering are necessary to improve the quality of Xeriscape design. In this way, a less costly and healthy Xeriscape design is provided (Bayramoğlu, 2016). For this reason, natural plant use and well-designed irrigation system helps to reduce maintenance work.

Figure 7. Proper maintenance (URL-6)

2. Xeriscape Plants

According to Baykan and Birişçi (2013), some of the xeriscape plants are classified as follows;

2.1. Deciduous trees and shrubs,

2.2. Evergreen trees and shrubs,

2.3. Perennial covering plants,

2.4. Grasses,

2.5. Biannual seasonal flowers,

2.6. Succulents and cactus,

2.7. Palms and palm-like species,

2.8. Odorant plants.

2.1. Deciduous trees and shrubs

Acer campestre, Acer galabrum, Acer tataricum, Aesculus hippocastanum, Betula nigra, Catalpa speciosa, Celtis orientalis, Cercis sp., *Cotinus coggygria, Crataegus crus–galli, Elaeagnus angustifolia, Fraxinus americana, Ginkgo biloba, Gleditsia triancanthos, Hippophae rhamnoides, Koelreuteria paniculata, Liriodendron tulipifera, Populus tremula, Pyrus* sp., *Quercus robur, Quercus rubra, Robinia pseudoacaia, Sambucus nigra, Sambucus racemosa, Sophora japónica, Syringa vulgaris, Ulmus pumila, Ulmus parvifoli.*

2.2. Evergreen trees and shrubs

Pinus nigra, Pinus silvestris, Pinus mugo, Pinus strobus, Cupressus arizonica, Cupressus sempervirens, Taxus baccata, Thuja orientalis, Juniperus chinensis, Juniperus communis depressa, Juniperus horizontalis, Juniperus x media, Juniperus sabina, Juniperus scopulorum, Juniperus squamata, Juniperus virginiana, Berberis thunbergii, Buxus sempervirens, Campsis radicans, Caragana arborescens, Cotoneaster dammeri, Cotoneaster horizontalis, Cotoneaster salicifolius, Euonymus alatus, Euonymus fortunei, Euonymus japonicus, Hedera helix, Ligustrum japonicum, Ligustrum obtusifolium, Ligustrum vulgare, Lonicera tatarica, Lycium barbatum, Mahonia aquifolium, Parthenocissus tricuspidata, Prunus laurocerasus, Pyracantha coccinea.

2.3. Perennial covering plants

Achillea filipendulina, Achillea millefolium, Alyssum saxatile, Anemone sylvestris, Artemisia schmidtiana, Artemisia absinthium, Aspidistra elatior, Bergenia cordifolia, Campanula carpatica, Campanula rotundiafolia, Cerastium tomentosum, Euphorbia polychrome, Festuca glauca, Gaillardia aristata, Gaura lindheimeri, Gazania linearis, Helianthemum nummularium, Heliopsis helianthoides, Hemerocallis hybrids, Iberis sempervirens, Iris germanica var, Lamium maculatum, Lavandula angustilfolia, Liatris spicata, Linum perene, Lychnis coronaria, Narcissus spp., Nepeta faassenii, Phlox subulata, Salvia argentea, Thymus serpyllum, Tagetes lemmonii.

2.4. Grasses

Agropyron cristatum, Festuca arundinacea, Poa pratensis.

2.5. Biannual seasonal flowers

Cosmos sulphures, Gomphrena globosa, Leonotis nepetifolia, Portulaca grandiflora, Zinnia elegans.

2.6. Succulents and cactus

Aloe saponaria, Aloe vera, Euphorbia tirucalli, Kalanchoe fedtschenkoi, Opuntia humifusa, Stapelia spp., *Tradescantia pallida*

2.7. Palms and palm-like species

Acrocomia aculeata, Beaucarnea recurvata, Brahea armata, Butia capitata, Chamaerops humilis, Chrysalidocarpus lutescens, Cocos nucifera, Cycas revoluta, Cycas circinalis, Dioon edule, Jubaea chilensis, Livistona chinensis, Livistona decipiens, Phoenix canariensis, Phoenix dactylifera, Phoenix reclinata, Phoenix rupicola, Sabal mexicana, Sabal causiarum, Sabal domingensis, Sabal etonia, Sabal palmetto, Serenoa repens, Trachycarpus fortunei, Washingtonia filifera.

2.8. Odorants Plants

Salvia officinalis, Thymus vulgaris, Lavandula angustifolia, Origanum majorana, Eucalyptus sp., *Pelargonium* sp.

CONCLUSION:

One of the most important problems that make life difficult in cities is that the water resources are about to be exhausted. It is required that attention should be paid to the concept of "xeros landscape design " which is one of the landscape designs and applications that provide effective use of water in ecological approaches for urban sustainability and to make significant changes in landscape design understanding in urban areas for effective use of decreasing water resources.

A large quantitiy of the water resources are used for the purpose of irrigation. As alternative water sources, treated water can also be used for green areas in urban areas. As Karaca and Kuşvuran (2012) pointed out, irrigation of the areas such as parks and gardens, trafic island (road middle pavements) and grass covered areas in urban areas involving ornamental plants is largely carried out using municipal water supply. This leads to high consumption of high quality drinking water.

The practice of watering green areas using water supplied from the drinking water network should be abandoned and these areas should be watered with alternative sources such as wastewater treatment plants. Taner (2010) and Eşbah (2010) argued that the systems where water from rain and snow can be stored should be built especially in many countries in residential areas, and that these systems can also reduce overuse of underground water resources during periods of drought.

Until recent years, aesthetics in the concept of landscape design was at the forefront, while nowadays, the concept of usefulness, being economic and sustainable design understanding has come to the forefront. One of the most important causes of this change is that the world's water resources give dangerous signals that can be exhausted. Taner (2010), Eşbah (2010), Karaca and Kuşvuran (2012) stated that they should abandon the classical landscape concept in the newly created green space designs and adopt the new landscape design principles that best suit the existing conditions.

In plant designs; plant species resistant to aridity consuming less water should be given higher priority than others. Natural plant species are more adaptable than foreign native plant species. As a matter of fact, Taner (2010) and Eşbah (2010) stated that natural plants are more resilient than foreign-origined plants and are affected less than regional climate extremes, contribute to soil fertility, decrease erosion and generally require less water, fertilizer and more.

As Çetinkale Demirkan and Akat (2017) also pointed out, projects should be led in the pilot regions in order to make use of water-efficient practices in city landscapes without sacrificing visual quality. When the climate change and the disasters it creates are taken into consideration; Xeriscape, a landscaping application that protects both the environment and the water efficiently, must be given serious consideration for these reasons.

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