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Effective use of water in the landscape architecture curriculum

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Abstract

Water is an indispensable life source for all living creatures, and such a vital source is being increasingly polluted and running out due to lack of effective use. Aridity is on the rise due to water cycle issues caused by global warming and, as such, water is becoming more and more a limited resource for the future. Necessary measures should be taken immediately to prevent this outcome. Training and awareness raising campaigns for effective use of water play a significant role in this respect. Striving to ensure the sustainable use of natural resources for improving the living quality of humans, landscape architects take various courses on the effective use of water throughout their education from the preservation, planning, design and management aspects of such endeavor. Topics such as xeriscape landscape designs, effective irrigation methods, choice of right vegetation, effective use of water resources and assessment of water resources on ecological level are considered to be significant elements of landscaping studies in tackling water scarcity issues brought on global warming and aridity. The present study aims to emphasise the place and significance of landscape architects and landscape architecture, as an academic study, in tackling the issue of water scarcity, which is an important issue on a global scale. With this aim in mind, the courses and syllabuses concerning the effective use of water included in the landscape architecture programs teach in both Turkey and around the world have been identified. The case studies on the effective use of water resources in Turkey and elsewhere have been studied and the things to be done in this respect have been presented.

Keywords: Water, climate change, xeriscape landscaping, landscape architecture programs.

1. Introduction

Being an indispensable resource for living creatures, water is being polluted and running out due to lack of effective use. Owing to the increase in population, water is being used intensively in various

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different areas and this leads experts to suggest that there will be a worldwide water scarcity in the coming years. The existing green spaces in urban areas require the use of water both for functional and aesthetic purposes. Many recent studies emphasise the significance of the effective use of water by taking into account the concept of sustainability. McHarg (1969) believes that the disciplines of landscape architecture and planning can achieve the sustainable development goals for humans only in as much as they manage to integrate the nature and natural processes into their planning and design studies and suggests that such a process will take a lot of time in urban areas due to lack of natural elements. According to Seckin et al. (2011), the basic principles of sustainability have been established through nature-oriented methods, regional uses based on climate conditions, intervention in the existing situation through existing vegetation, excavation and filling and the rehabilitation of the distorted landscape (Gurbuz & Aridag, 2013). Corbaci, Ozyavuz and Yazgan (2011) holds that the aim of landscape planning is to maintain the balance and sustainability of preservation and use within the relationship between humans and the nature, and that, as a scientific discipline studying the structure, function and change of landscape from an ecological perspective, the discipline of *'landscape ecology'* provides a significant basis in identifying the complicated structure of the nature as well as in planning and management of landscape. From a hydrological point of view, vegetation such as forests and meadows are significant elements for urban spaces. With the dense housing projects in urban areas, the green spaces there increasingly diminish, as a result of which rainwater fails to penetrate into the soil and thereby feed the groundwater (Corbaci et al., 2011).

In this respect, special practices such as water harvesting, water catchment gardens and rain gardens have increasingly become the significant components of the urban green space systems in urban landscape designs that are developed within the scope of rainwater management plans, which are considered to be the significant components of the urban landscape plans all over the world (Cakiroglu, 2011).

Ertop (2009) suggests that while the landscape architecture practices of the previous years were mostly concentrated on improving the quality of environmental surrounding and rehabilitating the disrupted environmental conditions, in the recent years there was an increase in the sensible use of water and cultivating xerophytic plants because of the worries inspired by global warning and drought (Yazici et al., 2014).

Striving to ensure the sustainable use of natural resources for improving the living quality of humans, landscape architects take various courses on the effective use of water throughout their education from the preservation, planning, design and management aspects of such endeavor. Within the scope of this study, the topic of effective use of water in landscape architecture programs in both Turkey and elsewhere around the world has been examined along with relevant case studies.

2. Effective use of water in landscape projects

Constituting a significant element of landscape projects, water resources are used for various different visual and functional purposes in the form of ponds, pools, waterways, fountains and sprinklers in all kinds of outdoor settings ranging in scale from a garden of detached house to an urban park where recreational activities are performed.

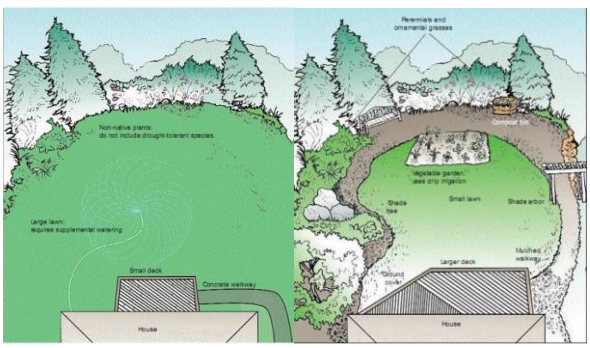
As products of urban landscape panning, green spaces are significant places in supervising and assessing the water management process in urban areas. Considered as significant components of urban landscape plans all over the world and developed as part of the rainwater management plans, the practices such as water harvesting, water catchment gardens and rain gardens constitute the significant parts of the urban green space systems in urban landscape designs (Anonymous, 2007; Cakiroglu, 2011).

Green spaces in urban areas are designed and continue to be designed in a manner that is incompatible with the increasing water shortage. They include water-intensive lawns, local or foreign plants that require frequent irrigation. Such water requirement increases even more during the hot

summer months. Water conservation measures in landscape design have emerged in proportion with the increase in water requirement and water consumption (Cakiroglu, 2011).

There are two different approaches to the water effective landscaping: the first approach involves the use of natural life resources. Maintenance of sustainable landscaping involves the use of resources that is necessary for plants to continue their lives as part of the survival strategy. The second phase involves the effective use of natural resources in landscaping in a careful and moderate manner. In landscape architecture, water is used for two different purposes, namely, for irrigation and as a design element. In order to ensure the life of plants, suitable soil conditions have to be maintained. Today, most residential gardens are designed to include rain and snow water storage systems for irrigation. With this way, water is taken from water reservoirs in times of aridity (Baris, 2014).

Solutions intended for the effective use of water were commonly put into practice in the southern states of the USA, especially in Colorado and Florida, in the 1980s, and further developed by Denver Water Department in 1981, and such planning method came to be called xeriscaping (Baris 2007; Gary L. Wade et al., 2009; Bayramoglu 2016). Xeriscaping involves water and power saving. In this respect, successful xeriscaping designs can be achieved with the completion of the following seven stages: planning and design, soil analysis, choice of suitable plants, practical grass areas, effective irrigation, use of much and suitable maintenances. A landscape design does not necessarily require the complete redesigning of a landscape in order to ensure water conservation. The important thing here is to consider the measures for ensuring the effective use of water. By employing the right planning techniques, it is possible to create effective landscape designs that are water-saving and environmental friendly. Xeriscape planning offers a good number of economic and environmental benefits including water, time, energy, labor, cash and maintenance saving and a suitable habitat for living creatures (Baris, 2014; Yazgan et al., 2010).



a b

Figure 1. An example of xeriscape design (http://www.agaclar.net/forum/peyzaj-bahce-duzenleme/12285.htm)

The garden located in Pueblo, Colorado – designed based on xeriscape methods and comprising an area of approximately 13,000 m^2 – is divided into sections based on the differences in water requirement, such as arid and semi-arid sections, so as to reduce water losses in irrigation. The park features more than 240 varieties of perennial ground cover plants, 15 ornamental lawn types, 35 bush varieties and 30 types of trees. Figure 1(a) shows the state of the garden prior to xeriscaping and Figure 1(b) shows the garden after it has been xeriscaped (Figure 2).

Figure 2. An image pertaining to the Colorado xeriscape design (http://coloradowaterwise.org/XeriscapeColorado)

Another xeriscape design project conducted by a private landscape architecture firm has made use of sustainable materials in the garden (Figure 3).

Figure 3. An image from a xeriscaped garden (http://www.theaustinlawnservice.com/xeriscape/)

The issue of increasing water scarcity in Turkey has been influential in the recent landscape planning and design works. The first of such efforts started as a result of the ecological park design contest launched by the Foundation for Supporting the Activities Valuing the Environment in 2009 in the Turkish Republic of Northern Cyprus. The park designed in Alsancak-Karavas based on xeriscape principles consists of an area of 300 m^2.

The second xeriscaping project was conducted in a 800-m^2 green park in Sariyer, Istanbul, where drought-tolerant plant varieties were classified based on their water requirements and planted along with the existing plants through bark mulching, turning the green area into a sustainable urban park. Moreover, such efforts both at home and around the world also include the construction of 'Green Buildings', accredited by internationally recognised bodies such as LEED and BREEAM for the purpose of ensuring energy saving, and the installation of systems that are capable of catching and storing rainwater and treating toilet and bathroom water to be used for garden irrigation purposes (http://ekoiq.com/%E2%80%9Ccimlere-basmayin%E2%80%9Ddan-%E2%80%9Ccimleri-ekmeyin%E2%80%9De-xeriscape/2/).

3. Materials and methods

The curricula followed in Undergraduate Landscape Architecture Programs offered by various universities in Turkey and abroad are chosen as the material for this study. Among the said curricula, the syllabuses of the following courses have been examined with respect to the effective use of water: *Landscape Art History, Landscape Ecology, Hydrology, Landscape Project, Design Studio, Irrigation and Sustainability*.

Within the scope of this study, the courses and syllabuses of 2 departments from African universities, 43 departments from American universities, 65 European universities, 15 Asian universities, 28 Turkish universities and 3 Northern Cypriot universities have been studied. Table 1 presents the universities that offer undergraduate landscape architecture programs.

Africa	Pretoria University Dschang university
USA	Canada Guelph University, University of Montreal, USA Academy of Art University, Arizona State University, University of Arkansas, Ball State University, Boston Architectural College [1][1] California Polytechnic State University, San Luis Obispo, University of California, Berkeley, University of California, Davis, City College of New York Clemson University, Colorado State University, University of Connecticut, Cornell University (College of Agriculture and Life Sciences, University of Florida, (University of Georgia (College of Environment & Design), University of Idaho, University of Illinois at Urbana-Champaign Illinois Technology Institute, Iowa State University, Kansas State University, University of Kentucky, Louisiana State University, University of Maryland, College Park Massachusetts Amherst University, Michigan State University, Mississippi State University, University of Nebraska & ndash; Lincoln, University of Nevada, North Carolina A & T State University, North Carolina State University, North Dakota State University, Ohio State University, Oklahoma State University, University of Oregon, Pennsylvania State University, Purdue University, University of Rhode Island, Rhode Island School of Design, Rutgers University, New York State University-Environmental Science and Forestry, Temple University, Texas Tech University, Virginia Polytechnic Institute and State University,Washington State University, West Virginia University, University of Wisconsin–Madison, UNAM (Universidad Nacional Autonoma de Mexico) Mexico
Europe	Technische Universiteit Delft (TU Delft) Delft, The Netherlands, Garden Design Academy, France,ETH Zurich, Zurich, Switzerland, HSR Technische Hochschule Rapperswil, Rapperswil-Jona, Switzerland, Agricultural University of Norway, Aas, Norway, Corvinus University, Budapest, Hungary, Technische Fachhochschule Berlin, Germany, Technische Universität Berlin, Germany, Technische Universitat Dresden, Germany, Hochschule fur Technik und Wirtschaft Dresden, Germany, Leibniz Universitaet Hannover, Germany, Technische Universitaet Muenchen, Germany, Fachhochschule Weihenstephan-Triesdorf, Germany, Hochschule fur Wirtschaft und Umwelt Nuertingen, Germany, University of Natural Resources and Applied Life Sciences, Vienna, Austria, University of Applied Arts, Vienna, Austria, Wageningen University, Wageningen, Holland, Cracow University of Technology, Cracow, Poland, Wroclaw University of Environmental and Life Sciences, Wroclaw, Poland, Instituto Superior de Agronomia, Lisbon, Portugal, Universidade do Porto, Porto, Portugal, Universidade de Evora, Evora, Portugal, Universidade do Algarve, Faro, Portugal, Universidade de Tras-os-Montes e Alto Douro, Vila Real, Portugal, Tartu Kolledz-Tallinna Technikaulikool (Tallinn Technical University), Tartu, Estonia, Eesti Maaulikool (Estonian University of Life Sciences), Tartu, Estonia, Estonian Academy of Arts, Tallinn, Estonia, Latvia University of Agriculture, Jelgava, Latvia, Vilnius Gediminas Technical University, Vilnius, Lithuania, ISIa Gembloux, Architecture du Paysage, Gembloux, Belgium, Haute Ecole Lucia de Brouckere de Bruxelles formations, agronomique, architecture-jardins-et-paysage, Belgium, Hogeschool Gent-Departement Biowetenschappen en Landschapsarchitectuur, Horticulture and Landscape Engineering Faculty, Nitra, Slovakia, Sveriges Lantbruksuniversitet, Alnarp, Sweden, Sveriges Lantbruksuniversitet, Uppsala, Sweden, University of Kavala Institute of Technology, Greece, Epirus University of Applied Sciences (TEI EP), Greece UNIVERSITY OF FORESTRY Sofia, Bulgaria, Neubrandenburg University of Applied Sciences (HS-NB), Germany, College Dublin University Ireland, Writtle School of Design (WSD), Edinburgh College of Art, Birmingham City University, Kingston University, London, University of Greenwich, London University of Gloucestershire, Leeds Metropolitan University, Manchester Metropolitan University, University College Falmouth, University of Sheffield, Accredited courses of the UK Landscape Institute England University of Turin, University of Genoa, University of Bologna, University of Rome La Sapienza, University of Reggio Calabria, University of Perugia, University of Palermo, University of Padova Italy University of Adelaide, University of Canberra, University of New South Wales, Queensland University of Technology, RMIT University, University of Western Australia Australia

Turkey	Adnan Menderes University, Ankara University, Gazi University, Artvin Coruh University, Bartın University, Canakkale Onsekiz Mart University, Cankiri Karatekin University, Duzce University, Cukurova University, Akdeniz University, Ataturk University, Inonu University, Istanbul University, Ege University, Kahramanmaras Sutcu Imam University, Karadeniz Technical University, Kastamonu University, Namik Kemal University, Istanbul Technical University, Bilkent University, Okan University, Recep Tayyip Erdogan University, Selcuk University, Suleyman Demirel University, Trakya University, Uludag University, Yeditepe University, Van Yüzüncü Yil University Eastern Mediterranean University, European University of Lefka Turkish Republic of Northern Cyprus (TRNC)
Asia	National University of Singapore, Singapore, University of Technology Malaysia, University of Moratuwa, Sri Lanka, Bogor Agricultural University, Indonesia, Chulalongkorn University, Thailand, Maejo University, Thailand, Kasetsart University, Thailand Silpakorn University, Thailand, Thammasat University, Thailand, National University of Seoul, South Korea, University of Seoul, South Korea, Beijing Forestry University, China, Tsinghua University, China, University of the Philippines Diliman, Republic of Philippines, The University of Hong Kong Asia Pacific

4. Effective use of water in the landscape architecture curriculum

The five criteria – hydrology, soil, vegetation, material and human health/welfare – introduced by ASLA in 2005 in line with the sustainable landscape design principles are included in various courses of the undergraduate landscape architecture programs. The European Council of Landscape Architecture Schools, founded in Norway in 1919, and the Council of Educators in Landscape Architecture, formed by four countries including the United States which originally launched its operations in 1920, are the institutions in which the educators in landscape architecture collaborate with each other and discuss the matters in hand at various conferences and that allows them to find a common ground regarding taking new decisions.

Landscape design studies are conducted in line with the principles introduced by the concepts of 'Water-Wise/Water-Smart Use', 'Low-Water Use' and 'Natural Landscaping', which fall under the general category of water-efficient landscaping.

An examination of the curricula of the landscape architecture programs offered by the universities listed in Table 1 suggests that they include the following courses that cover the topic of effective use of water: Landscape Art History, which covers the element of water used by various different civilisations throughout the history; Ecology and Landscape Ecology, which covers the relationship between living creatures and the environment as well as the climatic, physiographic and biotic elements necessary for the continuation of life and the impact of water resources required for them; Ecological Design, which covers the planning concepts in line with the aforementioned principles; Irrigation Design, which covers the use of water required for open green urban areas and the sustainability of the plant varieties used in such areas; Hydrology, which covers the topics of sustainability, presence of ground and surface water resources and the changes in such resources caused by environmental factors and human use; Urban Landscape Planning, which covers the planning studies conducted for the use of water in urban environment; Landscape Design, which covers the significance of water in shaping the land and the design principles that should be applied (http://laup.arch.tamu.edu/academics/undergraduate/bla/curriculum/); Land Form Design (http://catalog.illinois.edu/undergraduate/faa/academic-units/landscape/#majortext), which covers the significance of water in shaping the land through drainage systems and rainwater management; Landscape Dynamics (http://catalog.iastate.edu/collegeofdesign/landscapearchitecture/ #curriculumtext), which covers the degradation of water quality in ecological processes and current design strategies such as erosion and rainwater management and restoration of plant groups; Plant Recognition, which covers the water requirement and drought tolerance of various plant varieties in line with climate conditions; Vegetation Design, which covers both the planning and on-site studies

intended for establishing design criteria for plants based on their respective water requirements by taking into account various different locations, climate conditions and design principles.

5. Conclusion

The landscape architecture curriculum covers a range of principles regarding the planning and designing of outdoor and semi-outdoor spaces for meeting the needs of people in line with the ever increasing population growth around the world, in which theoretical methods are explained by the experts during the application stage. Water has recently gained prominence in the landscape architecture curriculum due to the rapid consumption of this life source in the 21st century. As a result of the studies conducted into the effective use of water, various principles have been established. In this respect, the most commonly applied way of effective water use is the method of xeriscape landscaping. The main principles of xeriscape landscaping include the inclusion of natural plant cover, use of ground cover plants instead of expansive grass surfaces, mulching and introduction of effective irrigation systems (Baris, 2007). The significance of plant material in the planning approach and the extensive coverage of plant recognition courses in the undergraduate study programs make the individual plant variety identification and thorough learning of their ecological requirements a necessity.

The contemporary landscape architecture curricula should pay attention to the current global issues and review the studies conducted on them, and provide the students with the knowledge relating to such issues and encourage them to discuss them during the lecture. Being our indispensable life source, water is rapidly and irresponsibly being consumed. Having been a threat for only arid areas of the world in the past, water is increasingly becoming a source of concern for everywhere in the world. Landscape architects should use water effectively in their application studies. The role of educators in this respect is to study the xeriscape design ideas for the effective use of water and to teach their students, throughout their education program, various applicable principles in their own region and elsewhere through field work. Before starting their professional careers, university students should improve their knowledge on the subject to be able to gain success in their application works and be guided in the right way for providing solutions to the current and future problems in that regard.

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