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SUSTAINABLE LANDSCAPING IN ISTANBUL TECHNICAL UNIVERSITY

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ABSTRACT: Universities have significant impacts on the environment because of their huge consumption of energy and materials. In the recent years, the universities have been considered as a role model of environmental responsibility. Over the last decades, some leading universities could perform significant sustainability projects in which sustainable landscaping of the campuses seems more effective. Istanbul Technical University (ITU) could also implement a list of renovations and green activities including rainwater harvesting (rain garden); bicycle usage program; forestry, irrigation system management, sustainable lighting, waste recycling, and green pesticide over its main green campus. This article with use of observational analyses makes attempt to survey the green projects operated in the open areas of Maslak campus as the main green campus of ITU. The article provides some suggestions for the campus admirations in order to increase the effect of the sustainable initiatives on the campus.

Keywords: Green campus, sustainability, landscape

İSTANBUL TEKNİK ÜNİVERSİTESİ'NDE SÜRDÜRÜLEBİLİR PEYZAJ

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ÖZET: Üniversitelerde, enerji ve malzemelerin büyük miktarı tüketilmesi nedeniyle çevre üzerinde önemli etkileri vardır. Son yıllarda, üniversiteler, çevre sorumluluğunun rol modeli olarak görülmektedir. Ayrıca, bazı önde gelen üniversiteler, daha etkili şekilde kampüslerin sürdürülebilir peyzajını önemli sürdürülebilirlik projelerinde gerçekleştirdiler. İstanbul Teknik Üniversitesi (İTÜ) yenileme ve yeşil faaliyetlerinin bir listesini; yağmur suyu hasadı (yağmur bahçesi); bisiklet kullanma programı; ormancılık, sulama sistemi yönetimi, sürdürülebilir aydınlatma, atık geri dönüşümü ve yeşil pestisit vb. faalitleri dahil olmak üzere ana kampüsünde yapılmaktadır. Gözlemsel analizlerin kullanıldığı bu makale, İTÜ, Maslak kampüsünün açık alanlarında gerçekleşen yeşil projeleri araştırmaya çalışmıştır. Makale,

sürdürülebilir girişimlerin kampüsler üzrinde etkisini arttırmak için kampüsler ile ilgi çalışanlara öneriler sunmaktadır.

Anahtar kelimeler: Yeşil kampüs, sürdürülebilir, peyzaj

INTRODUCTION

Campus sustainability has become an issue of global concern for university's policy makers and planners, as it has been recognized that the activities and operations of universities have a great effect on the environment. Sustainability is characterized by economic growth based on social justness and efficiency in the use of natural resources (Lozano, 2006; Barlett, & Chase, 2004; Aydin & Ter, 2008), and it includes all stakeholders' participation and cooperation are required to effectively achieve sustainability purposes. For a community to be sustainable, it requires management, conservation and improvement of its resources base, an elimination of deprivation and poverty of its residents, introducing of the concept of development which covers not only economic growth but also cultural and social progress (Quaddus & Siddique, 2006). Elizabete et al. (2005) have also identified five essential dimensions within the concept of sustainability, namely: ecological, social, economic, cultural and spatial. However, to measure the sustainability, there is no consensus about indicators. There is thousand successful example of the sustainability of city or university campus. Each of the prosperous cases has identified some specific aspects.

A sustainable university is defined by Velazquez et al. (Velazquez et al, 2006) as ''A higher educational institution, as a whole or as a part, that addresses, involves and promotes, on a regional or global level, the minimization of negative environmental, economic, societal, and health effects generated in the use of their resources in order to fulfill its functions of teaching, research, outreach and partnership, and stewardship in ways to help society make the transition to sustainable lifestyles''. Cole (Cole, 2003) also defines a sustainable campus community as the community that operates beyond its local and global responsibilities to improve and protect the health and well-being of ecosystems and humans. It involves the knowledge of the university community to address the recent and future challenges of ecology and society. Sustainability assurance means that the whole expenses of development projects are identified, mitigated, and compensated (Piper, 2002; Kurdoğlu, 2009).

A sustainable campus should have a healthy environment, with minimum negative effect on the environment through energy conservation, waste reduction, biodiversity protection, sustainable materials and efficient environmental management as well as relevant educational programs. Actually, a sustainable university campus implies a better balance between economic, social and environmental goals in policy formulation as well as a long-term perspective about the results of the present campus operations (Newman, 2006). Sustainability impacts every aspect of a university, from the classrooms and laboratories to dormitory, transportation, and other services, and to the whole campus (Alshuwaikhat & Abubakar, 2008). In the recent years, the universities have been considered as a role model of environmental responsibility. Over the last decades, the leading universities could perform significant sustainability projects in which sustainable landscaping of the campuses seems more noticeable and effective (Leal Filho, 2000; Özdemir Işık & Demir, 2017; Mat, et al, 2009). This article makes a revision of the general green initiatives established in some leader universities.

Istanbul Technical University (ITU) could also implement a list of renovations and various activities with the approach of sustainability including rainwater harvesting (rain garden); bicycle usage program; forestry, irrigation system management, sustainable lighting, waste recycling, and green pesticide usage over its main green campus. This article with use of the qualitative method of observational analyses makes attempt to survey the green projects operated in the landscape of Maslak campus as the main green campus of ITU.

Universities can have significant impacts on the environment because of their huge consumption of energy and materials. In the recent years, the universities have been considered as a role model of environmental responsibility. Over the last decades, the leading universities could perform significant sustainability projects in which sustainable landscaping of the campuses seems more effective. Istanbul Technical University (ITU) could also implement a list of renovations and green activities including rainwater harvesting (rain garden); bicycle usage program; forestry, irrigation system management, sustainable lighting, waste recycling, and green pesticide over its main green campus (Figure 1).

Figure 1. Bicycle usage program in Istanbul Technical University

After providing a general view of the universities' green operations on their campus, this article aims to analyze the green operations related to the landscape sustainability on the Maslak Campus of the ITU. According to the qualitative and observational survey of the campus landscape, the article makes attempt to evaluate the efficacy of those green initiatives performed on the campus. This survey is based on the sustainable principles defined for the open areas and mainly focuses on the effect of the green activities on improving the environmental sustainability and students' awareness.

Literature review: Green Campus Initiative

The literature review includes some examples of the main green initiative performed in the leading universities that are committed to becoming sustainable. There several strategies and factors considered for the sustainability of the landscape and open areas in the universities' campuses which are listed in table 1.

Table 1. List of the most common green initiatives performed in the open areas of the universities' campuses

Objectives	**Green Initiatives**
Saving Energy	Composting, Bicycle Program, Roof garden
Water Conservation	Irrigation techniques, Rain water harvesting, Roof gardens
Soil Conservation	Native Species Plant Selection, Rain garden
Biodiversity Protection	Conserve Natural Areas, Tree protection, more greenspaces, Using Native Plants
Storm Water Management	Porous pavement, Roof gardens, Rain gardens,
Environmental Awareness	Recycling Awareness, Composting,
Waste management	Composting, Recycling bin
Integrated pest management	Reducing Use of Pesticides by Community Stewardship (manually)

Improving watering techniques and irrigation system

Turfgrass and plants need water only when necessary, preferably in the morning (Bayramoğlu, 2016). Watering in the afternoon can lead to evaporation, whereas watering at night encourages fungus growth in lawns and beds. In the Bulent University, it uses rain sensors to turn irrigation system off when rain is detected. Watering is scheduled for early morning hours to avoid the problems of evaporation or fungal growth.

Facilities Services staff of UC Berkely have continued to research new technologies that make irrigation "smarter", which automates irrigation management. Irrigation management will be further improved by a "weather station" that will provide the irrigation system real-time or predicted weather information so that grounds are not over watered (UC Berkely, 2008). Butler University utilizes sprinkler shut-off valves combined with timers. These sprinklers include quick shutoff valves and programmable timers that allow the University to closely regulate water use (Figure 2). These two features, in conjunction with careful monitoring and checking of soil conditions by grounds crews, are effective in conserving water used for campus irrigation needs (Indiana Wild Life Federation, 2014).

Figure 2. A Rainbird sprinkler (Url 1).

Using Porous Pavement

In order to tackle climate change and the decline of freshwater resources availability, campuses are conserving water and promoting low impact development (LID) by implementing initiatives that reduce impervious surfaces and the energy needed to supply water. Permeable and porous paving products are increasing in availability for pedestrian areas, paths, parking, and other hardscape areas. Permeable paving contains enough void space to allow water to infiltrate runoff into the underlying soil. Porous pavement helps recharge groundwater and removes up to 80% of pollutants such as sediment, trace metals, and organic matter. Permeable and porous pavements allow the infiltration of rainwater and the treatment of runoff from adjacent impervious areas (Gardner et al, 2011).

Creating Rain Garden

Water or rain garden is a kind of open space that helps with storm-water management. Deep-rooted native plants and grasses are planted, which capture rainwater runoff and stop water from reaching the sewer system. The basic idea of a rain garden is to capture stormwater runoff from impervious areas like roofs, driveways, walkways, parking lots, and compacted lawn areas and divert it into vegetated areas instead of having it run off into the storm sewer system (Figure 3). They can enhance sustainability because they:

- Reduce flooding by slowing/catching/retaining stormwater runoff
- Improve water quality by filtering pollutants/sediment from runoff
- Teach students about the water cycle

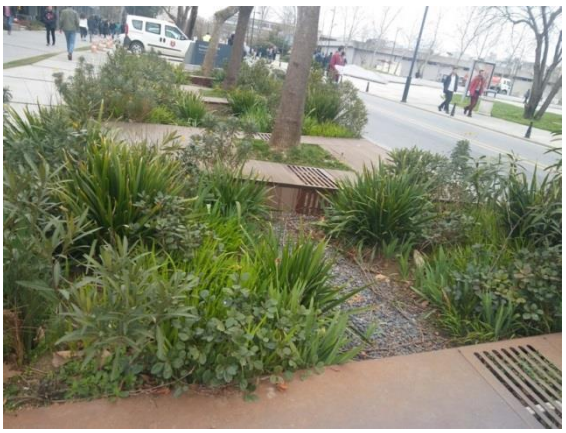

Figure 3. Examples of Rain water in the Universities' Campus

Composting

The Butler University designs a composting system to collect yard waste (grass clippings, fallen leaves, and branches) and recycles it as mulch. This organic material already contains nutrients that microbes can release to replenish the soil. Rich soil can absorb and filters rainfall (Figure 4) (Indiana Wild Life Federation, 2014).

Figure 4. All offices on campus have a landfill and commingled recycling. There are 92 recycling clusters (Berthas) strategically located across Campus to meet the recycling needs of the University of California. Other waste, such as green waste, is collected in subgrade green waste dumpsters. The green waste is collected by our waste hauler and turned into mulch before being returned to the campus grounds in landscaping (Byrn et al, 2013).

Gardens and Farming

Natural and cultivated landscapes across campus play a critical role in maintaining a healthy ecosystem. While plantings and vegetation keep soils healthy, they also contribute to cleaner air and water, provide shading and improve energy efficiency for buildings, and provide habitat for wildlife (Princeton Campus Plan, 2016) The Western Washington University campus has a five-acre farm and community garden with forty available plots for students to grow anything as long as it is organic. At Hampshire College (MA), work-study and summer internship positions are available for students who are interested in working with the community supported agriculture program (Sofer & Pottern, 2008).

Green Roofs

A "green roof" is a roof of a building that is partially or completely covered with vegetation and soil. Green roofs provide energy savings (insulation for both heating and cooling), water runoff reduction, increased roof lifespan, aesthetic improvements, and other environmental benefits (Pouya & Demirel, 2017). Examples of successful green roof projects include Carleton College (MN) and Massachusetts College of Art (Figure 4). It is o the first green roof project to use only plant species native to the state. The project included the installation of the roofing systems, irrigation, plants and about 30,000 pounds of soil (Deval L. Patrick et al, 2008).

Figure 5. HASSELL Unveils Living Roofs at the University of Melbourne's Burnley Campus (Url 2).

Using native plants in campus landscaping

In order to combat invasive species threats and to maintain adaptive plants, Arizona State University established a policy of using native species in campus landscaping that are drought tolerant and adapted to the harsh desert conditions, requiring minimal watering and fertilizers (University Leaders for a Sustainable Future, 2001).

Reducing use of pesticides

The University of Washington-Bothell has decided to bring in goats to help combat weeds on campus. The goats have been used in combination with other organic methods to remove weeds, including cutting and mechanical removal, as well as adding wood chips in the planting beds (Deval L. Patrick et al, 2008). Butler University, in order to reduce herbicides and pesticides, identifies which plants can target and determine the best eradication approach for each pest. it also limits pesticide use drastically and reduces environmental impact by manually removing all but the common pest. Another strategy of the Bulter University is use phosphorus-free fertilizer on campus lawns and landscapes (Indiana Wild Life Federation, 2014).

Plan of the "Host Community Stewardship Days" in the Butler University enlists the volunteers to help remove invasive species from campus, and teach community members and students about the importance of restoring habitats back to natural conditions. Indiana community is invited to help remove invasive garlic mustard from the campus (Figure 6). Students and community members are also taught how the plant causes harm to habitats around campus (Indiana Wild Life Federation, 2014).

Figure 6. Several volunteers pulling garlic mustard in the campus of Butler University (Indiana Wild Life Federation, 2014).

Bicycle program

In an effort to reduce greenhouse gas emissions from student, faculty, and university vehicles, campuses are implementing innovative methods to reduce vehicle fuel usage (Figure 7).

-Giving Free Bicycles to First-Year Students: Ripon College (WI) gives a free bike, helmet, and bike lock to the first 200 incoming freshmen who agree to leave their cars at home for the first year.
-Bike-Share Programs: At St. Lawrence University (NY) its Green Bikes Program allows students to check out bicycles for two days at a time with the same ID card they use to check out books from the library (Deval L. Patrick et al, 2008).

Figure 7. Staff is provided with bikes as part of ORNL's green transportation initiative (Deval L. Patrick et al, 2008).

-Bike Commuter Parking Pass: Free one-day car parking permits are now available to Duke University (NC) bike commuters. Students and employees who rely primarily on their bikes to commute to campus can receive up to 12 one-day parking passes, allowing them to park in visitor lots around campus at no cost when weather conditions or other needs demand they bring a car to campus.

-Bike Repair Classes: The University of Victoria Promotes events such as bike repair classes, other seminars, and bike locker rental opportunities to increase its profile and use. The University of Oregon has a variety of bicycle parking designs, including wave and hanging bicycle parking (Figure 8). The wave design allows for easy parking and retrieval, while the hanging design conserves more space (Chan et al, 2008).

Figure 8. Hoop bicycle parking at the University of Oregon (Source: U of O BMP, 2002).

Rainwater harvesting

Yale University's Kroon Hall has installed an innovative rainwater harvesting system that will pay for itself in about 10 years and is expected to save 500,000 gallons of potable water

annually (Figure 9). The rainwater harvesting system will provide water for flushing toilets, as well as for irrigating the native fauna in the campus (Deval L. Patrick et al, 2008).

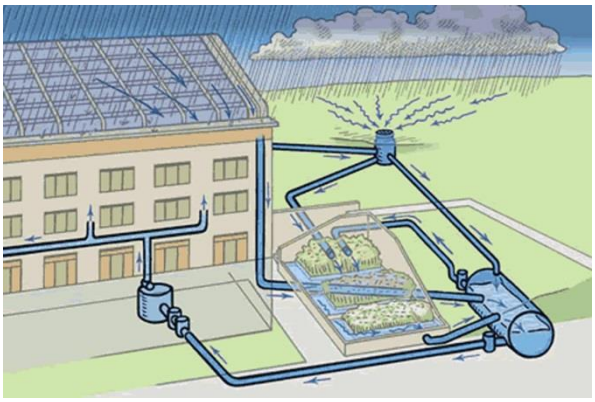

Figure 9. Rainwater Harvesting System at Yale University: Stormwater from the roof and the ground collects in a tank at upper right, which empties into a pond, where it is cleansed and diverted into larger harvesting tank. The water in harvesting tank is pumped to another tank for use inside and back into the pond.

MATERIALS AND METHODS

After providing a general review of the leader universities as to the landscape sustainability, this article focuses on the green operations of Istanbul Technical University in where a significant number of green initiatives have been executed over last years. A qualitative method has been used in this article. According to an observational survey of the campus landscape, the article evaluates the efficacy of the green operations performed on the campus. This survey is based on the sustainability principles defined for the open areas and mainly focuses on the influence of the green activities on the environmental sustainability and students' awareness improvement.

Green Campus Project in ITU has been started since 2015. In environmental planning, all ecologic, economic, and social qualities are considered. Sustainable landscaping works started with the cooperation of Istanbul Regional Directorate of Forestry, Istanbul Metropolitan Municipality and Landscape Department academicians of Faculty of Architecture. The main goal of the Green Campus approach protects the green space and make it more qualified. It also aims to support biodiversity and keep a high environmental quality. Design and implementation studies that are carried out in accordance with sustainable landscape principles are:

Land use management

It gives priority to the usage of pedestrian/ bicycle, allow for convenient circulation of disabled users and contribute as much as possible to the sustainability of natural life (Figure 10).

Figure 10. Maslak Campus is planned to be a total of 6 kilometers of the planned cycle and pedestrian way.

Figure 11. The road across the library was paved and warmed up in the summer. The rainwater there was not able to mix with the soil in this part before. With the infrastructure and landscaping in this region, the area has become a more livable area.

Native plant selection

Plant species that consume as little water as possible, which are suitable for a specific place in all seasons were preferred according to the vegetation regulation principles in the campus. In some cases been found that even properly selected trees dry and die over time, as the maintenance work has not been carried out. The campus's natural-life vegetation's were listed. The trees in this inventory are classified. Diseased and unhealthy trees have been moved to new areas where experts can guide and grow more easily. During the move, special tools were used that would not damage the roots of the trees.

Figure 12. Native plant selection in ITU Campus

Afforestation

The new afforestation work has begun taking into account such factors as how much the trees in these regions receive the sun, how efficiently the soil is, the distance from other trees in terms of healthy growth. With all these efforts, steps were taken to ensure rich and healthy plant diversity within the Campus.

Irrigation system management

Irrigation system and equipment preferences are realized in order to reduce the consumption of water based on the necessary water for the plants 'survival.

Energy consumption

A safe, economical and aesthetic lighting approach with low consumption (mostly using LED technology) and long life lighting has been adopted and applied in the campus.

Material selection

Corten is the rusted steel and this rusted metal has some positive landscape effect. In fact, plants need it specially, as it is typical chemical fertilizers. In this context, it is beneficial for the lawn and plants where the Corten is mixed with soil in the rainy weather and support for the growth of the plant (Figure 13& 14).

Figure 13. The Material Used In This Structure Was Not Colored. So, Over The Time, The Corten Is Washed Up Into The Soil And Afford The Necessary Fertilization Of The Soil.

Figure 14. The Seating Bands Are Made Of Natural Materials In ITU Campus

Permeable concrete

It is necessary to create a walkable ground on the campus, as it is a circulation-intensive region. Permeable concrete, which people can easily use, was used on the campus. İTÜ's own resources have been used by academicians from the Faculty of Civil Engineering in Maslak Campus. When it rains in our camp, water gets mixed with the soil. Thanks to the application of permeable concrete, there is no mud and water deposits in the middle when it rains.

Rainwater harvesting by rain gardens

Some plants in the campus have a high water-holding capacity. These are the plants used in the rain gardens. Another feature of these plants is that they can absorb Carbon. The asphalt water is filtered by these plants and the water enters the canal and finally discharge into Gölete Lake in the ITU (Figure 15).

Figure 15. The Rain garden in front of the Selfish Café in Maslak, ITU

Lightening improvement

In-campus lightening has begun to be used to renovate and fix types of lightning that will give identity to the place. As far as possible, LEDs and power LED light bulbs were used instead of metal halide, incandescent, and fluorescent lighting (Figure 16).

Figure 16. LED Light Bulbs In ITU Campus

Car Parking Management

In order to have minimum carbon emissions within the campus, student and guest car parks were moved to central locations. In these areas, appropriate infrastructure works were done for the parking usage and the necessary signposts were set up. In order to minimize the carbon emissions, the service vehicles were directed to a remote area of the forest. Thus, traffic and carbon emissions and natural life were the least damaged.

Waste Management

Efforts are being made to develop a nature-friendly system for decomposing and recycling chemical wastes, especially in laboratory work. For this purpose "Waste Management Commission" was established. For the recycling of daily wastes, recycling boxes for paper, plastic, and glass waste were installed on the Ayazağa Campus (Figure 17).

Figure 17. Recycling Boxes In ITU Campus

Water Conservation

Gölet located at Maslak Campus, the pond is fed from the rainwater collection project. No trees are used for the watering of the trees and the vegetation cover, the pool is saved and the water is being used. Biofilter method is used to keep the rainwater and accumulates in the pond (Figure 18).

Figure 18. Golet In The North Part Of The Maslak Campus, ITU

Before in the Golet, the high speed of extra water caused havoc around. With the new operation, water will flow down from the open channel to the collector in a controlled manner. The water is provided with minimum energy consumption to be transferred to the irrigation systems by taking advantage of the topography when drought is experienced.
In order to sustain the biological diversity of the Golet, the studies were carried out with the contributions of Istanbul University. Since the lake area is located within the area of bird migrations, it was also supported by bird observation groups. All the bird, plant community, all the fish living in the lake, butterfly beetles, observed and recorded.

Wildlife Protection

There are various species of birds such as parrots, hawks, and magpies on campus. Campus lanterns are being planted and livestock is being studied. Reptiles, squirrels, kippers, cats, and dogs are other animal species living on the campus (Figure 19).

The spread of the pine-bug beetle in the forest of ITU, the trees were drying out. This situation was also detected by engineers from the Provincial Directorate of Forestry. With the support of the Bird's Nest project, it was attempted to make the sparrows return to the forest and reduce the population of the pine bugle.

In the areas where the dogs were gathered, cabins were built to meet their eating and drinking needs. Dogs and cats were all vaccinated. Bird nests were placed all over the campus. These sockets are designed in a suitable type for the sparrows. With the bird nests, the sparrow population gradually increased.

Figure 19. Bird Nests Were Placed All Over The Campus.

RESULTS AND DISCUSSION

Maslak Campus as the main green campus of Istanbul Technical University has achieved significant green projects over the last decades such as: greenery and planting, conservation projects which includes both plants and animal protection, usage of sustainable technologies in waste and water management, Lightening, and construction, saving water by planting native species and catching rainwater, bicycle roads and some other activities. However, according to the observational analysis, there are some points that need to be considered. Waste management on the campus is summarized to put some recycling trash boxes which are not distributed equally over the campus. Recycling boxes that separate the trash are not placed in the restaurant, cafes and various places on the campus.

Even though native planting have been performed on the campus, there no any informational billboard that gives data about the species and their characteristics especially about some new activities like rain gardens. Despite the huge connected roads for biking on the campus, University doesn't give bicycles to the students and there is no rent program in benefit of the students who don't have the bicycle. In addition, it seems that bicycle parking is not defined and enough over the campus. So, just a few students ride bikes to reach the further parts and discover the campus. The Maslak campus has vast green open areas with nice landscape. However, there is so definite information and clear evidence which shows the ITU's students' collaboration in the executive operations.

Even though the observational analyses used in this work have provided general view and explanations about the activities, it cannot provide a valid and reliable data about the exact effect of the operations. It seems that next step for ITU and Maslak campus is to get the students' perception and understanding of the projects performed on the campus.

Campus as a sustainable model for the rest of city needs to convey its messages to the all students, staff, and subsequently the whole society. It is a questionable issue that how much the students receive the green changes on the campus and how they evaluate these activities based on their knowledge about the sustainability.

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