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Water Conservation and Management Practices at the University of Sharjah to Achieve Sustainability Excellence

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Abstract The University of Sharjah is a leading educational and research institution in the Gulf region. To stimulate the different aspects of sustainability in education and research as well as to ensure the implementation of sustainability concepts throughout the University campus operations, the concept of sustainability circles is implemented. The University being in hot-arid-zone and mostly surrounded by desert terrain relies on unconventional water conservation programs and initiatives such as the use of innovation & technology, reuse and recycling of water, and awareness campaigns. In line with such programs, the use of potable water is limited for hygiene purposes and wastewater generated within the University is reused after treatment to irrigate the vast green spaces through the most efficient irrigation water application systems. Examples of water conservation practices include use of efficient water devices, reuse of treated greywater for toilet flushing at a selected location, water quality monitoring, preservation to conserve water for its intended use, promoting waterless car wash on the campus grounds etc. On-campus water is also conserved through disseminating knowledge and awareness to the University community and beyond through various sustainability-related programs and initiatives organized by Sustainability Office for water conservation and environmental protection.

Keyword:

University of Sharjah, water conservation and management, sustainable practices, water reuse, efficient water devices

1. Introduction to University of Sharjah and its Sustainability Policy

The University of Sharjah was established as a non-profit institution for higher education in 1997 by His Highness Sheikh Dr. Sultan Bin Mohammed Al Qassimi, member of the Supreme Council, Ruler of Sharjah and President of the University to be the first university in the Emirate of Sharjah, United Arab Emirates (UAE). It is located in the core of the University City within the Emirate, few kilometres from the shores of the Arabian Gulf. The University has five campuses that are located at all of the Sharjah regions, including Khorfakkan and Kalba, as shown in Fig. 1.

The University has expanded in a relatively short time and has become the largest university in the UAE. It includes 14 colleges offering more than 85 various academic programs (majors) at the diploma, bachelor, master and PhD levels. At the moment, there are about more than 14,000 students enrolled at the University with academic staff that consists of 610 faculty members having diverse international experience and renowned stature.

The University's architecture represents its Islamic and Arabic heritage with splendid buildings and captivating landscape. The total area of the main Sharjah campus is 2.26 millions-m² including planted vegetation over 1.5 millions-m², forest vegetation over about 500m² and total floor area of 517,000m². The campus provides spacious, exceptional facilities that incorporate multimedia lecture rooms and halls, advanced scientific and research laboratories, dedicated libraries rich with information resources, state-of-the-art IT infrastructure and computer labs, theatres, clubs, two major sports complexes for both male and female students, student centres having several restaurants and variety of shops, and numerous other facilities as well. In addition to that, separate residential areas for male and female students and faculty members are available on campus.

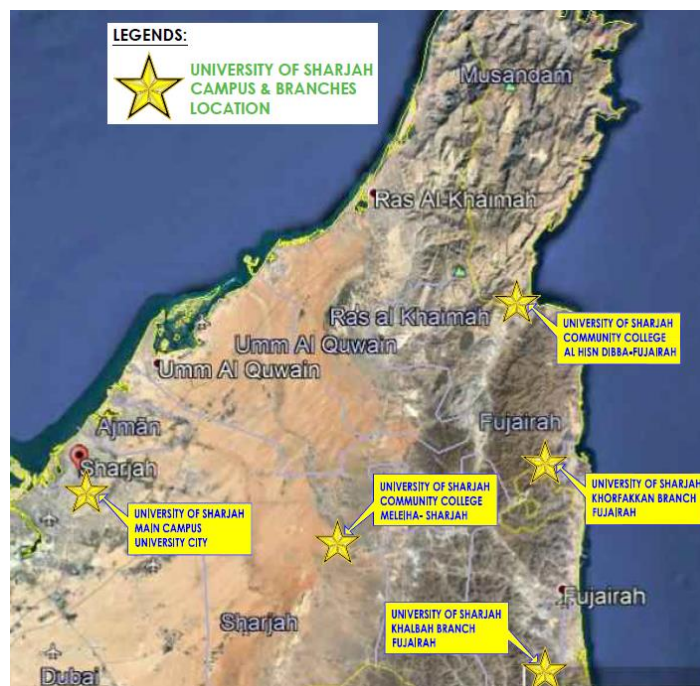


Figure 1: Location map of University of Sharjah main campus (Source: Google Maps).

1.1 Sustainability Policy at the University of Sharjah

One of the main goals of the University is to become a leading educational institution regarding sustainable development. To read more about vision, mission and goals of the University, visit the webpage: <https://www.sharjah.ac.ae>. To fulfil this aspiration and ambition, University is taking action to integrate the various aspects of sustainability in education and research, as well as practically implementing such concepts throughout the campus.

Towards attaining the sustainable development in the University, the Sustainability Office has been assigned with the following responsibilities:

- Be a front line institution in terms of sustainable development
- Setup cooperative relationships to promote and encourage sustainability
- Expand production and usage of effective research associated with social, economic and ecological development
- Regularly attain knowledge and adequacy in the teachings of sustainability
- Integrate and merge the teachings of sustainable development in different academic activities
- Establish expected solutions for activities that might have negative effects on social, environmental or economic advancement
- Frequently check and assess the university's work and achievement in sustainable development and advancement
- Look for and plan solutions and measures of improvement linked to the work in sustainable development
- Based on the capacity, implement technology and means which encourage sustainable development
- Offer sustainable solutions for students, staff and faculty members
- Imprint repercussion thinking in decisions which might influence sustainable development for students, staff and faculty members

1.2 Sustainability Office at the University of Sharjah

The University of Sharjah Sustainability Office was established in October 2017 to ensure sustainable development, preserve the environment, and accomplish an ideal balance between economic and social development that follows the UAE national agenda and the UAE vision 2021. The vision of the Sustainability Office is *"The University of Sharjah to become a regional and global benchmark for sustainability excellence in higher education."*

In addition, a Climate Emergency Letter has been signed, in September 2019, by the Chancellor of the University, which proclaims a Climate Emergency, and agreed to implement a three-point plan to handle the emergency through the work with students. The three-point plan includes:

1. Committing to going carbon neutral by 2050 at the very latest;
2. Mobilizing more resources for action-oriented climate change research and skills creation;
3. Increasing the delivery of environmental and sustainability education across curricula, campus, and community outreach programs

Furthermore, to embed the culture of sustainability across the campus, a comprehensive sustainability awareness campaign has been launched under the theme of "Sustainability 2020" in October 2019, where sustainability events, workshops and activities are being organized.

The Methodology of the Sustainability Office. To promote a culture of sustainability, the Sustainability Office works on minimizing the environmental impact and integrate sustainability in all campus life aspects and operations across the University. These efforts provide two types of improvements; "incremental" improvements achieved over time, or immediate "breakthrough" improvements. Thus, the "plan-do-check-act" (PDCA) cycle was the approach embraced to develop improvements. This approach proves to be an effective

tool to recognize opportunities to plan for carrying out changes, execute change on a small scale, study and measure the effectiveness of implementing these changes. If the change has been successful, it will be implemented on a wider scale while monitoring the outcomes continuously. Nevertheless, to accomplish the expressed vision, it is important to involve all the University stakeholders, and therefore a sustainability circle concept has been embraced and developed [1].

Sustainability Circles. The Sustainability Office has setup 30 sustainability circles in various sustainable areas. Each sustainability circle is usually led by a faculty member or a specialist who has the knowledge, experience and enthusiasm in the respective area of sustainability. These circles are very inclusive and connected to global sustainability ranking systems such as the UI GreenMetric World University rankings and the Sustainability Tracking, Assessment, and Rating System (STARS).

The Structure of Sustainability Office. Sustainability Circles concept is built on the principle of the well-known notion of the Quality Circle, the main elements of the Quality Circle are available in the Sustainability Circle, (i.e., top management, steering committee, facilitator and coordinator, leader, members). Figure 2 shows the structure of the Sustainability Office at the University.

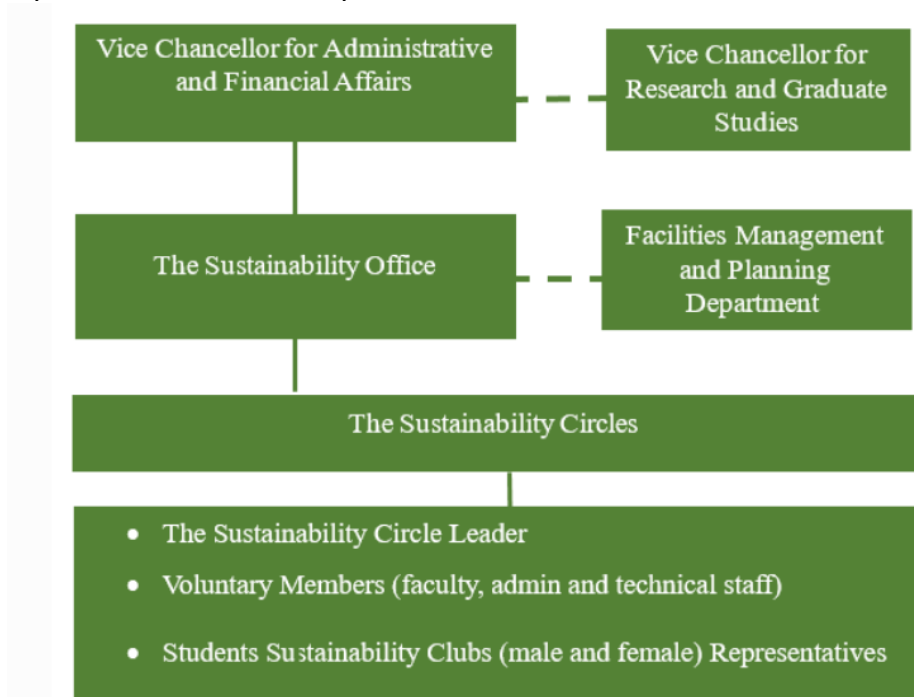


Figure 2: Structure of Sustainability Office (Source: [1])

2. Water Resources of University of Sharjah and its Usage

The University uses desalinated water to meet its daily demand of potable water. Sharjah Electricity and Water Authority (SEWA) supplies potable water through its network to University. The use of potable water is limited for hygiene purposes.

On the other hand, to meet the irrigation water requirements of vast green spaces, the University relies completely on the use of non-potable water. The source of non-potable water for irrigation is primarily the treated wastewater. Sharjah Municipality and University City services collect the wastewater generated within the University City, treat at a nearby University City wastewater treatment plant and supply back to irrigate green spaces, gardens, palm trees and plants. For hygiene reasons, a limited quantity of non-potable

groundwater, extracted from the borewells, is mixed with treated wastewater to irrigate the gardens in the close vicinity of academic buildings.

3. Water Conservation Programs and Initiatives

The University is located in a hot arid zone with permeable sand (desert) all around, thus the traditional water conservation methods such as ponds for rainwater harvesting etc. are not practicable. Therefore, the University implements water conservation through various programs and initiatives briefly discussed below.

3.1 Use of Technology and Innovation

Due to challenging water resources in the country [2] and harsh climatic conditions, the University emphasizes on innovate use of technology and adopts technology-based-innovative solutions to conserve the freshwater supply.

During the last two years (i.e., 2018-2020), the University replaced most of the non-efficient high flow water taps with the new efficient low flow nozzles and/or automatic taps in all academic buildings. Further, the replacement of high flow W/C flushing systems with the dual/automatic flushing system is undergoing. Meanwhile, to monitor the water consumption and to assess the daily and seasonal variability in water consumption at the campus, several smart water meters are also installed. Table 1 provides data of water-efficient devices installed during 2018-2020.

Table 1: Summary of water-efficient devices installed in the University during 2018-2020

	Replaced	% Replaced
Water-efficient nozzles	877	71.59
Automatic taps	241	19.67
Automatic/dual WCs	108	9.88
Overall	1226	52.89



Figure 2: (a & b) Faucet aerators: Automatic & low flow nozzle faucets installed in all academic buildings including on-campus mosques and (c) Smart water meter to manage water usage

For irrigation water application of green spaces, plants and palm trees, although treated wastewater is used, there is no compromise on water losses and wastage. Since, the conservation of water for the irrigation is very important, as it consumes a large amount of

water [3], the University adopted most efficient drip and sprinkler irrigation systems to irrigate the entire campus. Examples of these systems in operation are shown in Figure 3. Further, to optimize the use of treated wastewater, these systems can be operated as automatic, semi-automatic or manual.

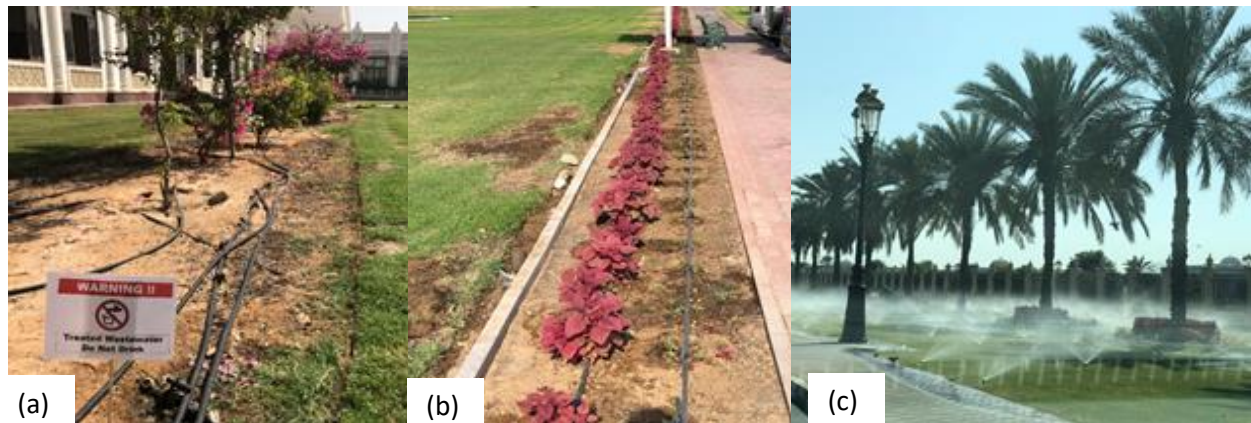


Figure 3: Use of Drip (a & b) Sprinkler (c) irrigation systems at the University

3.2 Reuse of Grey Water

The University is working on the reuse of greywater for toilet flushing and irrigation instead of sending the greywater to treatment plant after a single-use. Greywater reuse provides an unconventional water supply alternative that can help reduce the demand for potable water. In a recent pilot project, (Fig. 4) greywater reuse for toilet flushing is implemented in a students' dormitory.

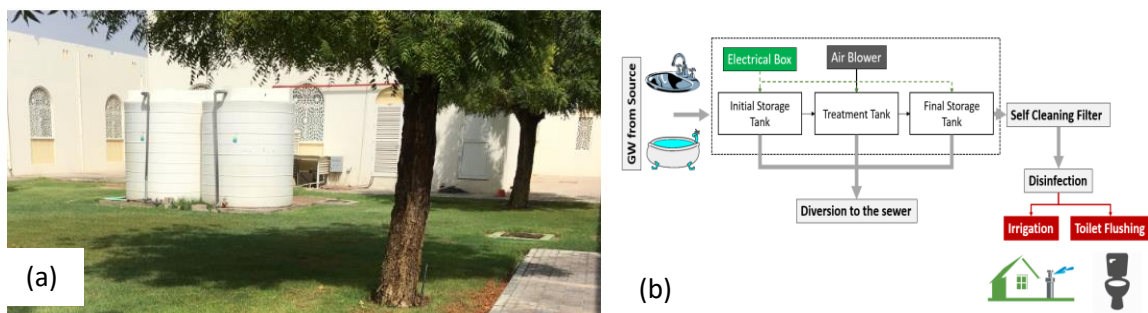


Figure 4: (a) Tanks of the greywater recycling system in the student dormitory, and (b) flow chart of the installed greywater recycling system (source: [4])

3.3 Recycle Treated Wastewater for Irrigation

Because the water resources are scarce, and the City of Sharjah depends on the costly desalination of seawater/groundwater, the wastewater is considered as a resource rather than a waste product. It is collected through a suction system and water tankers (if necessary) and delivered to a nearby wastewater treatment plant shown in Fig. 5 and pumped back (after treatment) to the University for reuse.

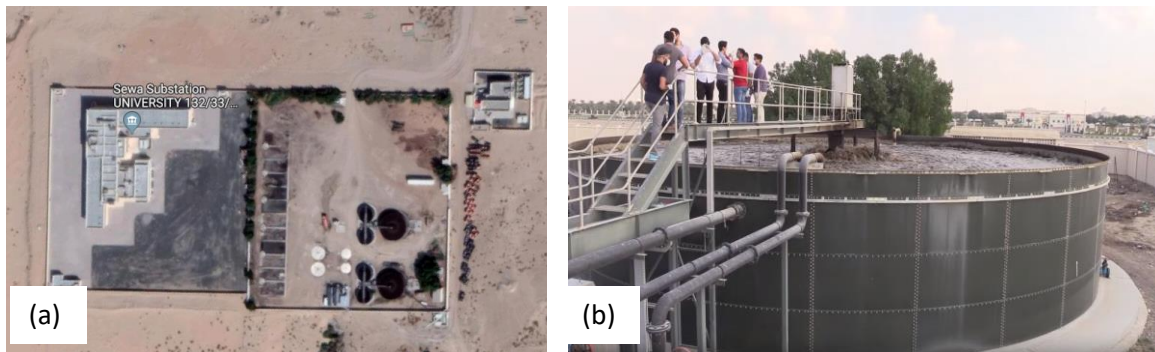


Figure 5: (a) University City Wastewater Treatment Plant layout, and (b) primary clarifier of the treatment plant

3.4 Awareness Campaigns, Initiatives and Education

The water is also conserved through disseminating knowledge and raising awareness ([2], [5], [6]) to the University community and beyond through various programs and initiatives for water conservation and environmental protection. Out of a total of 54 university-wide sustainability events organised during the last two years 2018-2020, selected events/initiatives are outlined below:

- The Sustainability Awareness Year 2020
- World Water Day and Earth Hour, 25 March 2019
- Water Conservation Workshop organized by SEWA, 28 April 2019.
- Wastewater Treatment and Reuse in Sharjah UAE, 2019
- Sustainable Garden Workshop
- Waterless Carwash Service in the Campus and so on

In an effort to embed further sustainability in education, starting from September 2020 the University will be offering two new sustainability-focused interdisciplinary graduate programs (i.e., MSc in Environmental Health and MSc in Environmental Science and Engineering). Further, in the academic year 2018/2019, a total of 127 sustainability-related courses were offered in different education programs of the University. Owing to these efforts, the University has witnessed a tremendous increase in sustainability-related research projects and publications. According to recent data of 2018-2020, a total of about 550 sustainability-related research papers were published by the University faculty and students. These educational and research activities are trusted to play a key role to cultivate environmental and sustainability conscience among students, faculty, staff and community.

4. Summary/ Concluding Remarks

For achieving the University's vision and mission of being world-class teaching, learning and research institution, the University of Sharjah receives unparalleled support of higher administration to carry its operations. To strengthen the University commitment in relation to sustainability goals and sustainable development, the roles of Sustainability Office and Sustainability Circles have been vital.

To achieve sustainability in water, the University adopted unconventional approaches due to its geographical location and climate condition. The water conservation programs, and management initiatives emphasize the use of technology and innovation, reuse and

recycle of wastewater, awareness campaigns and education of sustainability concepts through courses, degree programs and research.

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