ISO 14046:2016

INSTITUTIONAL WATER FOOTPRINT INVENTORY REPORT

Reporting Period: 2018-2022

Prepared by: HSE Department

Consultant: Quick Carbon

Report Date: 23.10.2023

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This report has been prepared jointly by the HSE Department and Quick Carbon.

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1. INTRODUCTION

Water is a finite and strategically vital natural resource essential for life. The world is currently grappling with a water crisis, driven by factors including population growth, industrialization, climate change, and other environmental issues. In our country, the annual per capita usable water supply has decreased from **1,652 m^3** in 2000 to **1,544 m^3** in 2009 and further to **1,346 m^3** in 2020 according to data from the General Directorate of State Hydraulic Works in 2020. This downward trend is expected to persist. Over the recent years, reducing water consumption and reusing water have taken on more importance, spurred by both national and international directives and the initiatives taken by companies. Enhancing water efficiency relies heavily on the identification, monitoring, reporting, and verification of water inventory and water footprint within the framework of ISO 14046 Water Footprint Standard. Prepared in accordance with the transparency principle, this report is intended to analyze Özyeğin University's institutional water footprint, showcase its commitment to the responsible management of water resources, and promote sustainability.

A water footprint is the amount of fresh water used either directly or indirectly. The direct water footprint represents the volume of water used in activities such as showering, washing dishes, doing laundry, and washing cars. In contrast, the indirect water footprint represents the volume of water used in production and the supply chain. Virtual water, on the other hand, refers to the water used to produce goods and services.

Water footprint: Calculated as three distinct components that reflect both usage and quality: blue, green, and grey water footprints.

Blue water footprint: Represents the amount of fresh water resources used directly or indirectly in the production of goods or services.

Green water footprint: Represents the total volume of rainwater used directly and indirectly in the production of goods or services.

Grey water footprint: Represents the volume of freshwater required to dilute the pollutant concentration in wastewater to meet the water quality standards.

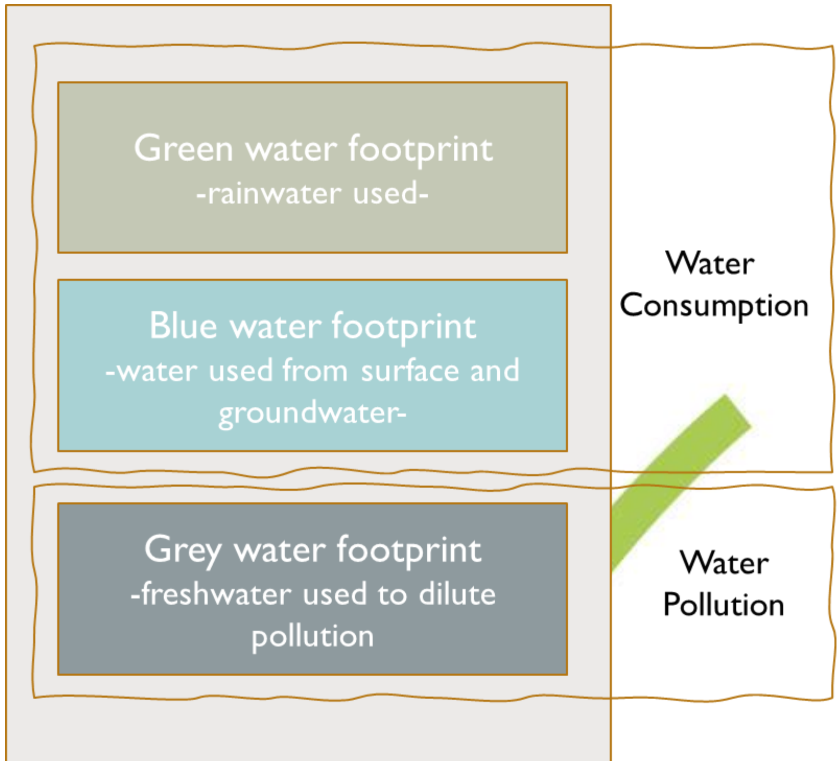


Figure 1. Water Footprint Components

Organizations should assess their impact on the water crisis and climate change, adhere to national and international climate change policies, and proactively manage their risks. This is a critical issue that has significant implications for both corporate and financial performance. The ISO 14046 Water Footprint Standard specifies basic requirements at the organizational level for identifying, reporting, and reducing the water footprint. It includes requirements for the design, development, management, reporting, and verification of an organization's water inventory. It also serves as a tool for limiting and mitigating greenhouse gas emissions.

This report is Özyeğin University's annual Institutional Water Footprint Inventory Report. Inventory is a measurement of the amount of water footprint directly attributable to the organization's activities within declared limits for the specified reporting period.

The reporting processes and calculations in this report are consistent with international protocols and standards. This report has been prepared in compliance with the requirements outlined in Section 6.2 of the International Organization for Standardization (ISO) 14046 Water Footprint Standard.

Terminology;

Direct water: For the purpose of this study, direct water refers to water consumed or used directly at Özyeğin University. This type of water use includes domestic use, garden irrigation and other human activities. Blue and green water footprints fall within the scope of direct water.

Indirect water: For the purpose of this study, indirect water refers to the water used in the production of consumed goods. This water includes the amount of water used to grow, process, or produce such goods. Virtual water footprint falls within the scope of indirect water.

Virtual water: Virtual water is a concept that expresses the total amount of water used in the production of goods. It measures the hidden or indirect water consumption, indicating that water is transported not only geographically but also through products. Virtual water is important for sustainable management of water resources and strategies to cope with water stress.

Chemical Oxygen Demand (COD): An indicator of water quality that measures the amount of oxygen required to oxidize organic and oxidizable inorganic compounds in a water sample.

Suspended Solids (SS): The term refers to small solid particles present in water and sewage, typically measuring around 1 micron or larger in size, but smaller than a grain of sand, for instance.

2. PURPOSE

This report was prepared for Özyeğin University with the following goals:

- Calculating the impact of the University's activities on the water crisis,
- Preparing for current and future legal regulations,
- Identifying risks and issues in water management,
- Reporting water footprint in compliance with ISO 14046,
- Contributing to the development of the Institutional Water Management Plan,
- Raising faculty, staff, and students' awareness of climate change, water efficiency, and sustainability.

This study is expected to have the following benefits for Özyeğin University.

In-house benefits:

- Transparency about the institution's water consumption
- Identification of opportunities for water efficiency
- Raising institutional awareness
- Laying the groundwork for the Water Management Plan
- Strengthening Özyeğin University's sustainability vision

External benefits:

- Reinforcing the institution's sustainability vision, and highlighting its environmental awareness
- Leading as a pioneer in the sector with similar studies

The **ISO 14046 - Water Footprint Standard** provides detailed information about the principles and conditions for designing, developing, managing, and reporting an institution's water inventories on the institutional or organizational scale. This standard includes requirements for identifying water inventories, calculating an institution's water footprint, setting forth water efficiency measures, and providing the institution with recommendations for specific activities to ultimately enhance water management. This standard also covers requirements and guidelines related to inventory analysis, quality management, reporting, internal audits, and the institution's responsibilities for verification purposes.

The principles outlined in the ISO 14046 standard for calculating and reporting water footprints are essential to guarantee the precise and fair assessment of water footprint-related data.

The ISO 14046 principles are as follows:

General: These principles are fundamental and will be used as a guide for decisions relating to the planning, conducting, and reporting of a water footprint assessment. The assessment can be conducted and reported separately as well as part of a life cycle analysis.

Life Cycle Perspective: An institution's water footprint assessment is performed just like a product's water footprint assessment, factoring in all activities over the entire life cycle.

Environmental Focus: A water footprint assessment covers the potential environmental impacts associated with a product, process, or organization. Economic or social impacts are, typically, fall outside the scope of the water footprint assessment.

Relative approach and functional unit: A water footprint assessment is related to a functional unit and the result(s) are calculated based on this functional unit.

Iterative approach: A water footprint assessment is an iterative technique. The stand-alone phases of a water footprint assessment use the results of the other phases. The iterative approach within and between the phases contributes to the comprehensiveness and consistency of the assessment and the reported results.

Transparency: The results are disclosed by providing sufficient and appropriate information in order to allow users to make decisions with reasonable confidence.

Relevance: Data and methods are selected such that they are appropriate to the user's needs.

Completeness: All data which make a significant impact on the water footprint are included in the inventory.

Consistency: Assumptions, methods and data are applied in the same way throughout the water footprint assessment to arrive at conclusions in accordance with the defined goals and scope.

Accuracy: Systematic errors and uncertainties are minimized as far as possible.

Priority of scientific approach: Water footprint assessments are performed based on natural sciences. Where this is not possible, other scientific approaches or international conventions can be used. If there is neither a scientific basis nor a justifiable approach based on other scientific methods or international conventions, decisions may be made, as deemed suitable, through value-based choices.

Geographical relevance: The water footprint assessment is conducted at a scale and resolution, which gives relevant results according to the goal and scope of the study and takes into account the local context.

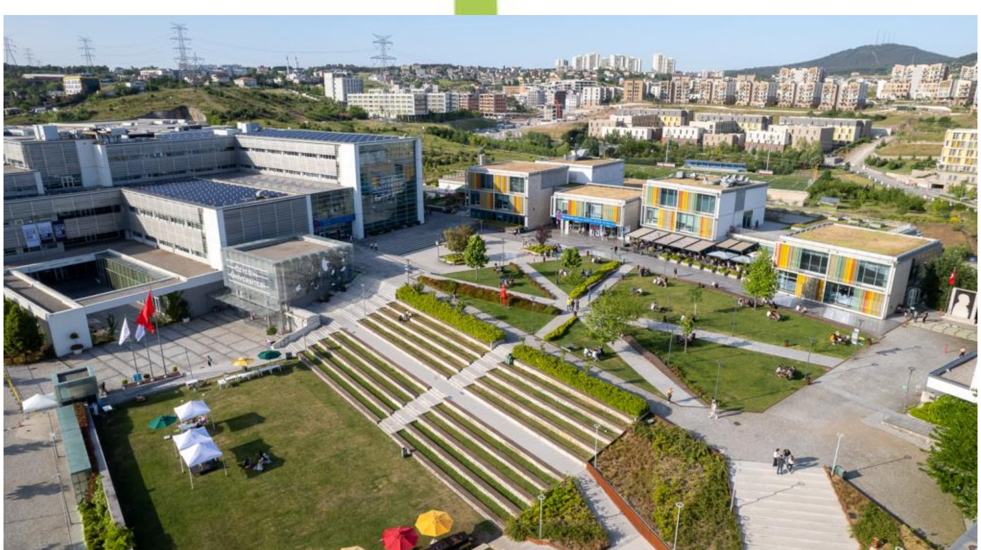
Comprehensiveness: A water footprint considers all environmentally relevant attributes or aspects of natural environment, human health and resources related to water.

3. PROCEDURE

3.1. SYSTEM BOUNDARIES

This report has been prepared for Özyeğin University's Çekmeköy Campus located at the address given below, and the system is limited to the respective campus only.

Address: Nişantepe Mah. Orman Sok. 34794 Çekmeköy - İSTANBUL



Picture 1. Özyeğin University Çekmeköy Campus

3.2. WATER FOOTPRINT CALCULATION METHODOLOGY

The methodology used for calculating blue, green and grey water footprint values of the water inventory complies with the requirements and principles of ISO 14046. It covers all the basic principles. The calculation methodology is as follows:

- Definition of the purpose and scope,
- Water footprint inventory analysis,
- Development of a water flow chart,
- Types of water resources used (including water withdrawal and water intake structures),
- Water usage areas,
- Amounts of water used (water withdrawal and discharge),
- Water quality data,
- Calculation of blue and grey water footprints, and uncertainty,
- Interpretation of the results,
- Land use changes, land management activities and changes in drainage, stream flow, and water evaporation to which the study boundaries relate.

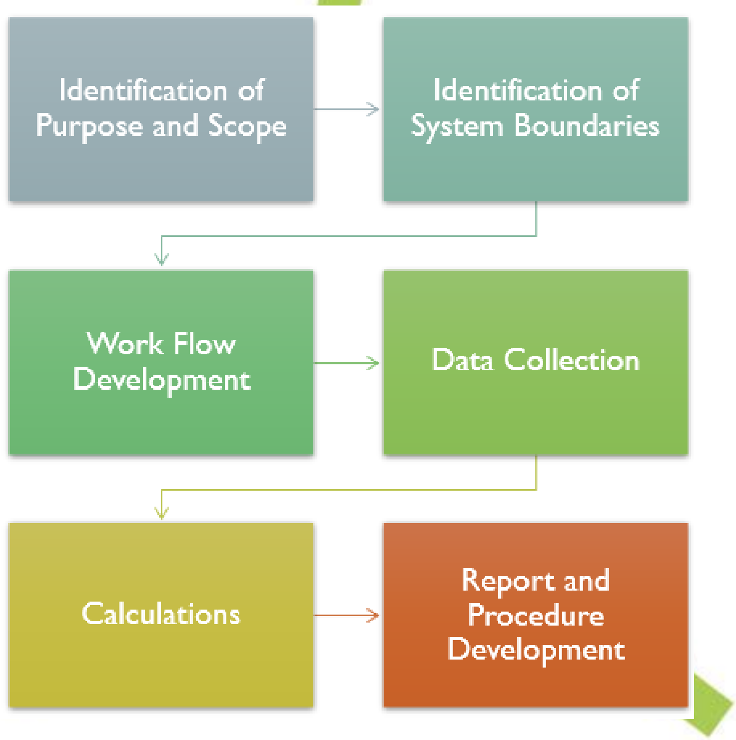


Figure 2. Water Footprint Inventory and Reporting Steps

In this report, Özyeğin University's virtual water footprint was initially calculated using data from 2022. These calculations will also be applied in future years outside the scope of ISO 14046. In order to determine the overall virtual water consumption on the campus, on-campus businesses were requested to provide data regarding the quantity of food and materials consumed in 2022. The food and materials to be included in the calculation were chosen by taking into account both their frequency of use and the amount of water consumed in their production. Relevant products and their virtual water footprints are listed in the table below.

Table 1. Products And Virtual Water Footprint Values

Product	Virtual Water Footprint	Unit
Pet bottle (piece)	5,3	(liter/piece)
Bread (one loaf of bread)	1.625	(liter/one loaf of bread)
Rice (kg)	2.497	(liter/kg)
Potato (kg)	287	(liter/kg)
Sugar (kg)	920	(liter/kg)
Tomato (kg)	214	(liter/kg)
Mutton (kg)	10.412	(liter/kg)
Chicken meat (kg)	4.325	(liter/kg)
Coffee (kg)	18.900	(liter/kg)
Tea (kg)	8.860	(liter/kg)
Paper (package)	2.550	(liter/pack)

3.3. PROJECT OWNERS

The people involved in the preparation of this report and responsible for coordinating the reporting of institutional water footprint calculations in accordance with the ISO 14046 standard are given in Table 2. With the guidance of the project owners, the data provided by Özyeğin University was used in the calculations.

Table 2. Project Owners for Özyeğin University's Institutional Water Footprint Inventory Report

Responsible	Title	Telephone	Email
Hikmet TAŞDEMİR	Özyeğin University – HSE Director	0 216 564 9459	hikmet.tasdemir@ozyegin.edu.tr
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Yağmur CAGLAYAN	QuickCarbon – Sustainability and Business Development Specialist	0 216 410 6135	yagmur.caglayan@altensis.com

3.4. DATA COLLECTION

Water footprint inventory data was provided by Özyeğin University's Health, Safety, and Environment Department. Mains water, which enters the campus from a single point, is distributed through three separate branches, each of which is measured with utility meters. There are 3 different wells on campus, which are named as follows according to their locations: Dormitory 4 (1), Airplane (2), Tennis (3). While two of these wells (Airplane Well and Tennis Well) were active in 2018 and 2019, they could not be used in 2020, 2021 and 2022 due to factors such as drought and construction. On the other hand, th Dorm 4 Well was actively used for landscape irrigation throughout the entire reporting period. There are three rainwater collection systems on campus, which are named as follows according to their locations: Dorm 2 (1), AB4 Car Park (2), Business Parking Lot (3). The Dorm 2 Rainwater Tank fulfilled its function in 2018 and 2019 and the stored rainwater was used for landscape irrigation. However, it could not be used in 2020, 2021 and 2022 due to drought and infrastructural problems.Nevertheless, the Rainwater Tanks No:2 and 3 are still being actively used. There are no meters in wells and rainwater tanks. Therefore, the calculations were made theoretically, relying on specific assumptions related to their storage capacity.

Water is used for domestic use, garden irrigation, and pool maintenance purposes on the university campus. There is no wastewater treatment facility within the campus, and used water is transported to Paşaköy Advanced Biological Wastewater Treatment Facility via the sewage system. The water treated here is discharged into the Riva River. Grey water footprint was calculated based on the discharge limits outlined in the Urban Wastewater Treatment Regulation and used as the effluent standard at the Paşaköy Wastewater Treatment Plant.

On the university campus, water is used for garden irrigation, pool maintenance and domestic purposes in most areas.

Water flow data of the Özyeğin University Çekmeköy Campus as well as information about water source, intended use, affected basin and receiving water body are given in Table 3.

Table 3. Water Flow Data

Water Source		Intended Use	Location	Basin	Latitude	Longitude	Receiving Water Body
Well 1 (Dorm 4)	Groundwater	Garden Irrigation	Çekmeköy Campus	Marmara Basin	41,031	29,258	-
Well 2 (Aeroplane)	Groundwater	Garden Irrigation	Çekmeköy Campus	Marmara Basin	41,031	29,258	-
Well 3 (Tennis)	Groundwater	Garden Irrigation	Çekmeköy Campus	Marmara Basin	41,031	29,258	-
Rainwater Tank 1 (Dorm 2)	Rain water	Garden Irrigation	Çekmeköy Campus	Marmara Basin	41,031	29,258	-
Rainwater Tank 2 (AB4 Parking Lots)	Rain water	Garden Irrigation	Çekmeköy Campus	Marmara Basin	41,031	29,258	-
Rainwater Tank 3 (AB2 Parking Lots)	Rain water	Garden Irrigation	Çekmeköy Campus	Marmara Basin	41,031	29,258	-
Mains	Ömerli Dam	Domestic Use, Pool Maintenance, Garden Irrigation	Çekmeköy Campus	Marmara Basin	41,031	29,258	Riva River

The water flow diagram created during the inventory analysis is given in Figure 3.

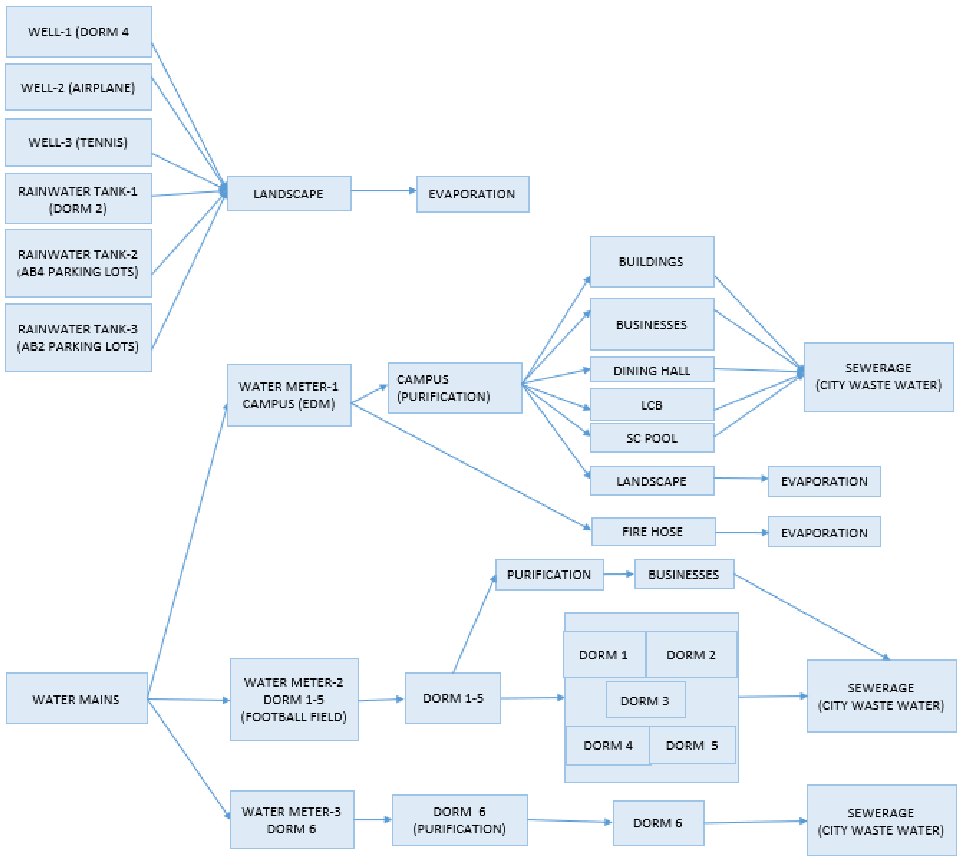
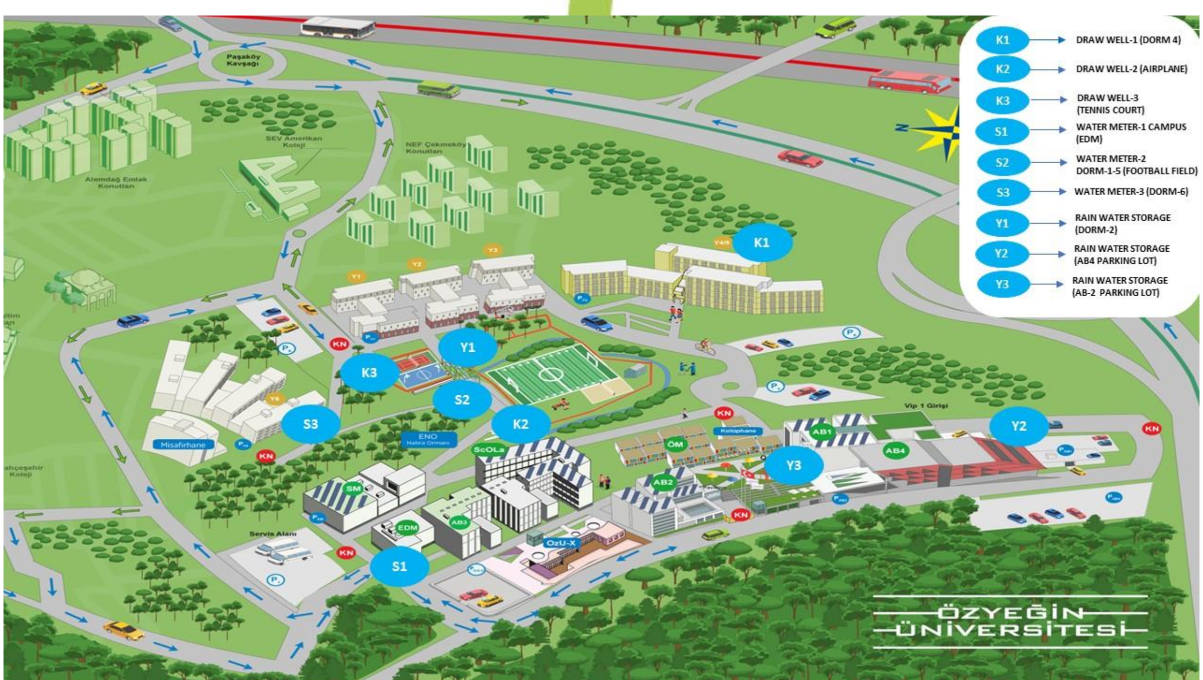


Figure 3. Özyeğin University Çekmeköy Campus Water Flow Diagram



Picture 2. Çekmeköy Campus Water Resources

4. RESULTS

Özyeğin University's water values are given in Table 4. The calculations for the total amount of evaporated water and wastewater were based on the assumption that 10% of the water sourced from the mains undergoes evaporation, while 90% of the water drawn from the mains is discharged as wastewater. (Öztürk, İ. (2017))

Table 4. Total Amount of Withdrawn Water, Evaporated Water and Wastewater

	2018	2019	2020	2021	2022
Total Water Withdrawn (m^3)	234.239	418.343	153.488	77.981	189.190
Total Evaporated Water (m^3)	27.388	45.798	18.049	10.498	21.079
Total Wastewater (m^3)	207.251	372.945	135.439	67.483	168.111

In 2022, Özyeğin University's blue water footprint value is 189,190 m^3. The grey water footprint value amounted to 245,088 m3 for COD (Chemical Oxygen Demand), 54,990 m^3 for SS (Suspended Solids), and 300,078 m^3 in total. The virtual water footprint was calculated as 1,842,182 m^3. The Institutional Water Footprint results of the Özyeğin University Çekmeköy Campus are given in Table 5.

Table 5. Institutional Water Footprint Results

Özyeğin University WF Values (m^3)		2018	2019	2020	2021	2022
Blue Water Footprint		234.239	418.343	153.488	77.981	189.190
Grey Water Footprint	COD	302.150	543.714	197.456	98.384	245.088
	SS	67.792	121.991	443.02	22.074	54.990
	Total	369.943	665.706	241.758	120.458	300.078
Green Water Footprint		1.120	1.120	720	720	720
Total Water Footprint		**604.581**	**1.084.449**	**395246**	**198439**	**489.268**

The water footprint calculations factored in the total number of faculty, staff, and students at the university. The density values are given in Table 6.

Table 6. Water Footprint Density Values

Water Footprint Density (m^3/ person)	2018	2019	2020	2021	2022
Blue Water Footprint	24,31	43,62	15,59	7,80	18,92
Grey Water Footprint	38,39	69,52	24,56	12,05	30,01
Green Water Footprint	0,12	0,12	0,07	0,07	0,07
TOTAL	62,82	113,25	40,23	19,92	49,00
Total Number of People (Faculty, Staff, Students)	***9.636***	***9.576***	***9.843***	***10.000***	***10.000***

Table 7. Water Footprint Density Values for 2022

(Virtual Water Footprint included.)

Water Footprint Density (m^3/ person)	
Blue Water Footprint	18,92
Grey Water Footprint	30,01
Green Water Footprint	0,07
Virtual Water Footprint	184,00
TOTAL	233,00
Total Number of People (Faculty, Staff, Students) 10,000	

The virtual water footprint was calculated based on the data received from the on-campus businesses and the main dining hall on the Özyeğin University Campus. When the results are examined, it can be seen that coffee is the highest contributor to the total water footprint among the products consumed by faculty, staff, and students, as illustrated in in Figure 4.

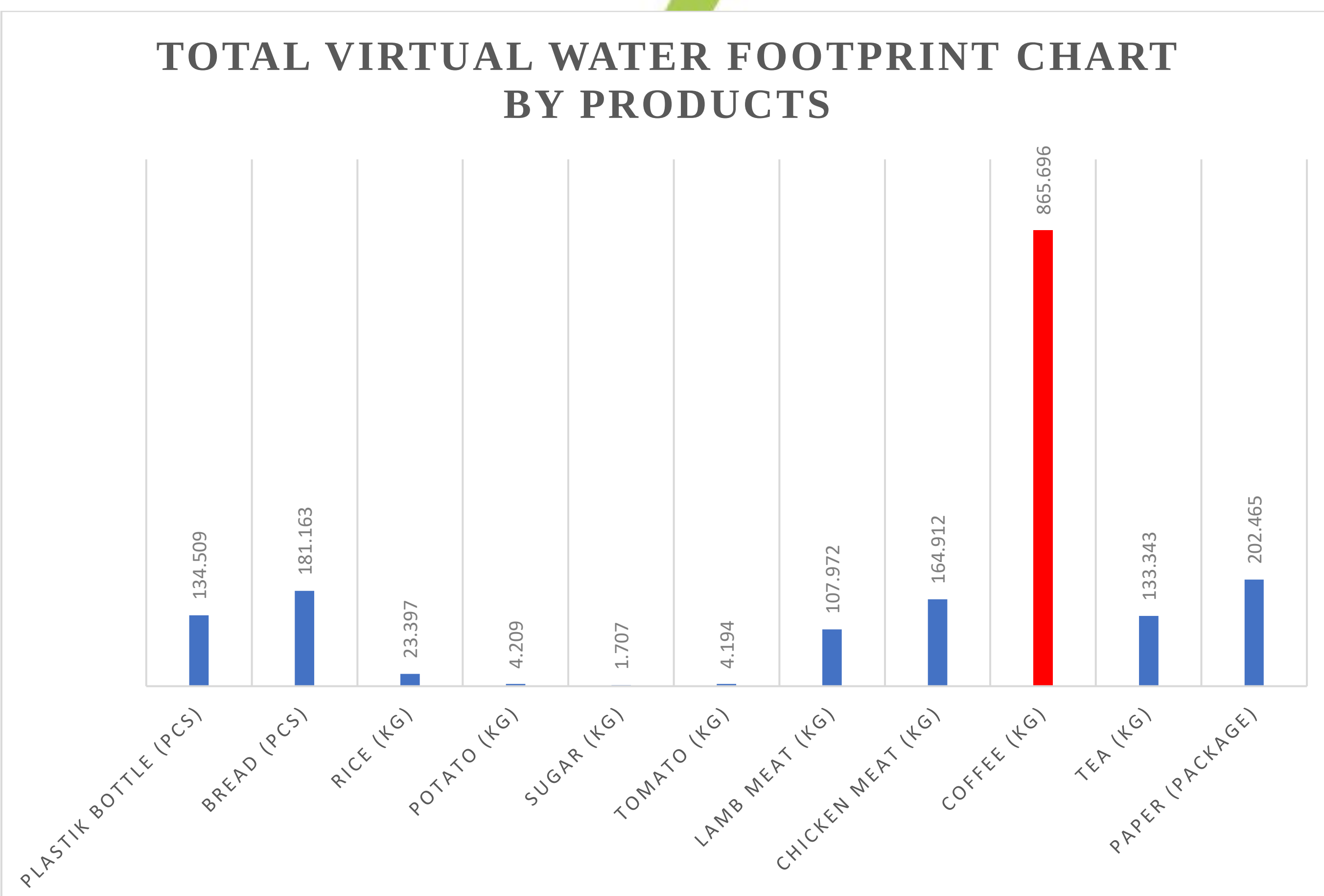


Figure 4. Total Virtual Water Footprint By Products

5. UNCERTAINTIES

In this inventory, the activity data used in the calculations consists of basic data provided from invoices approved by Özyeğin University and/or company meters, software or other recorded data. 90% confidence interval was taken as basis when calculating uncertainty.

As a result of calculations made with data from Özyeğin University, the overall uncertainty was calculated as ± 6.4%. Since this value remained below 10%, the calculation was deemed safe, and there was no need to conduct any sensitivity analysis.

6. CONCLUSION

While the total amount of water that forms the basis of life on Earth is approximately 1.4 billion cubic kilometers, 97.5% of this amount is salt water and is not suitable for consumption. Freshwater resources suitable for the use of living organisms are very limited. Many of these freshwater resources are found underground or in glaciers. However, the world population is constantly increasing, leading to a parallel surge in water demand, which is causing the already limited freshwater resources to be depleted uncontrollably. It is becoming more evident every day how important it is to make water footprint calculations to ensure the sustainability of water resources.

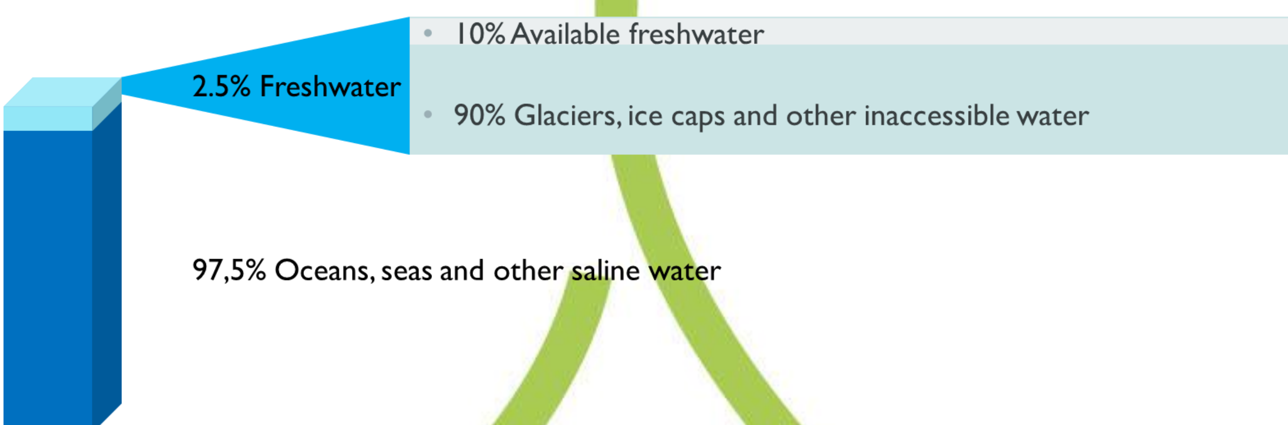


Figure 5. Distribution Of Water Resources In The World

The global distribution of freshwater resources is not equal. In regions with ample water resources and high population density, water stress diminishes, whereas less populated areas experience this stress due to their limited water resources. Water is indispensable for both human existence and economic activities, prompting certain countries to secure their economic sustainability through the prudent utilization of their water resources.

Although water usage varies depending on the level of sectoral development, the agricultural sector retains its position as the principal global consumer of water resources. Water is used in agriculture, especially to provide food for the growing population. At the same time, in underdeveloped or developing countries, water is also used as a source of income since a large part of the economy is based on agriculture.

Although domestic water consumption is quite low compared to other sectors, this type of consumption is a part of our daily life and creates both blue and grey water footprints. It can be said that changing our daily individual habits and making conscious choices in our domestic use of water can make a huge difference. Therefore, it is of paramount importance to conduct studies to increase awareness of water efficiency and sustainable water use.

In this study, Özyeğin University's total water footprint for 2022 was calculated as 2,332,169 m^3, including the virtual water footprint. 8% of this amount comes from blue water footprint, 13% from grey water footprint, and 79% from virtual water use. If the values are analyzed in terms of direct and indirect use of water, it is seen that 9% is due to direct use and 91% is due to indirect use.

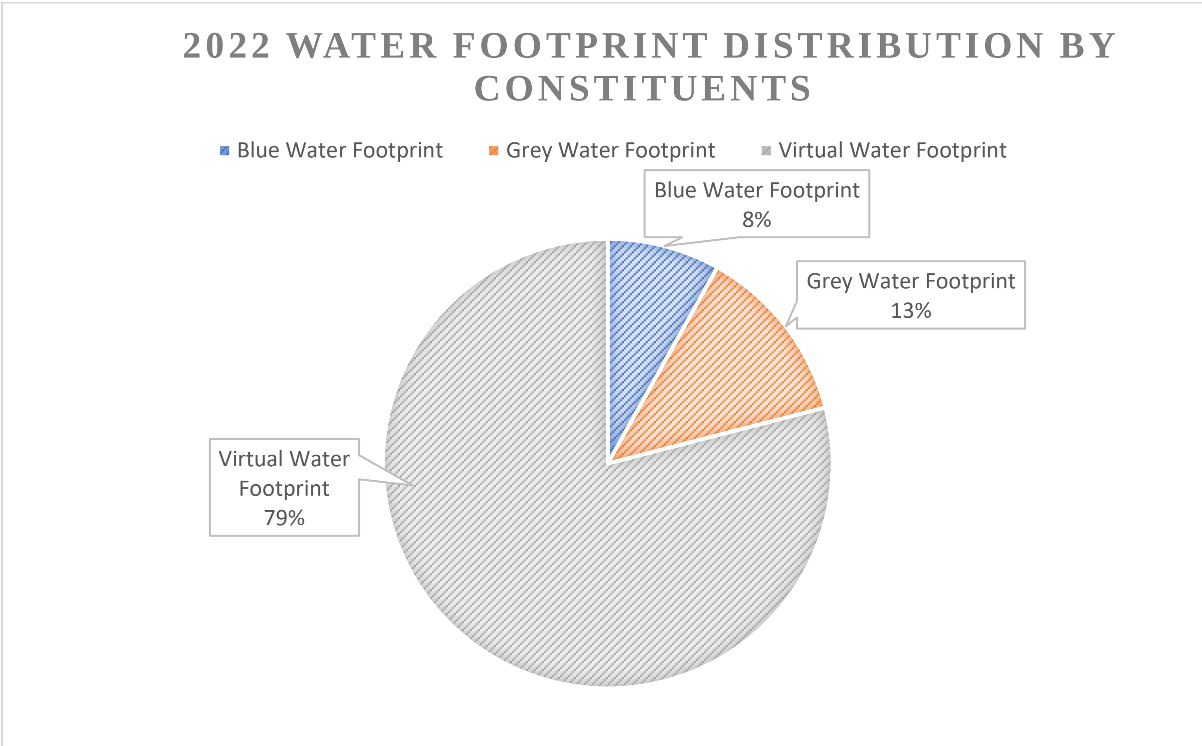


Figure 6. 2022 Water Footprint Distribution By Constituents

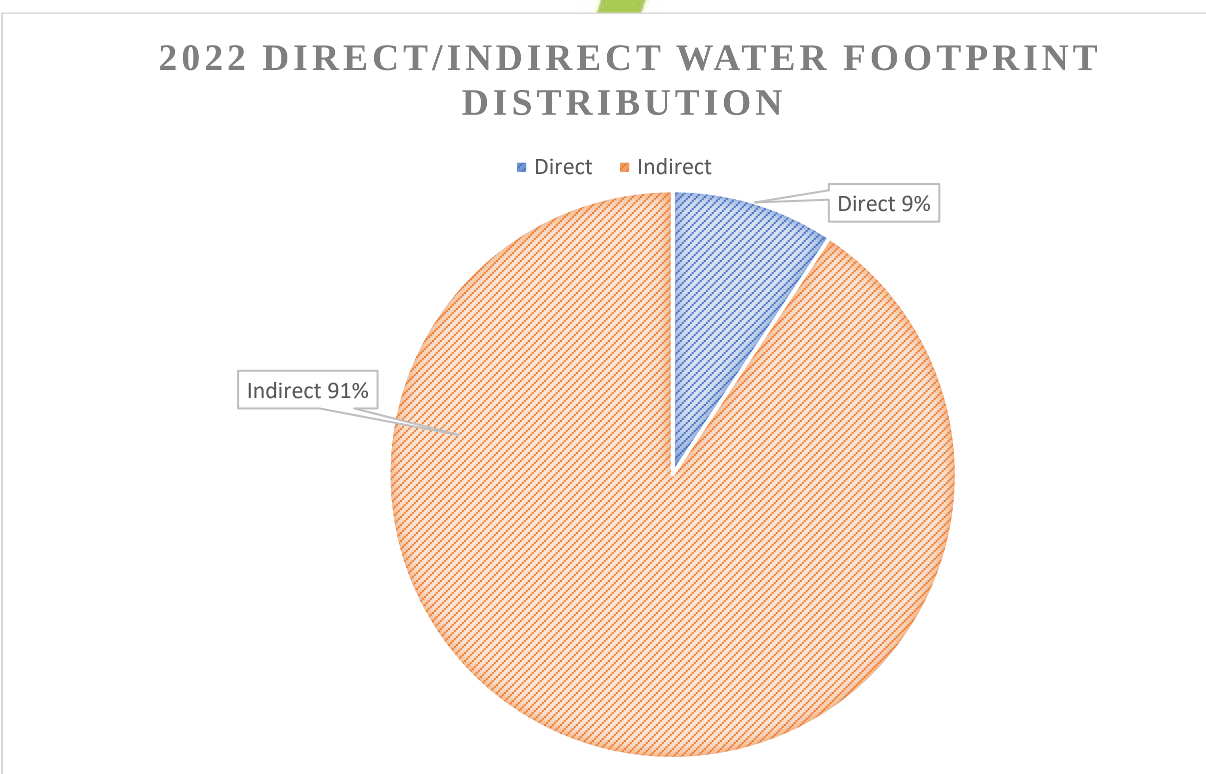


Figure 7. 2022 Direct/Indirect Water Footprint Distribution

While the total water footprint per capita in Türkiye is 79 m3, this figure increases to 1,977 m3 when virtual water is factored into the calculations. (WWF, 2014). At Özyeğin University, this value was calculated as 233 m^3. The implementation of water-saving measures across the campus and various water efficiency projects undertaken by the University account for this difference. Additionally, the fact that most students, faculty, and staff are on campus only during class times has a significant impact.

The table below compares the past and present blue water footprint calculations conducted for Özyeğin University. Upon reviewing the table, it is evident that there was a significant increase in water usage in 2019 compared to other years. The increased water usage can be attributed to the meter failures and infrastructure issues that arose after 2018, alongside the inauguration of newly constructed buildings. Additionally, it is seen that water consumption reduced drastically on campus following the transition to online education in 2020 and 2021 due to the pandemic.

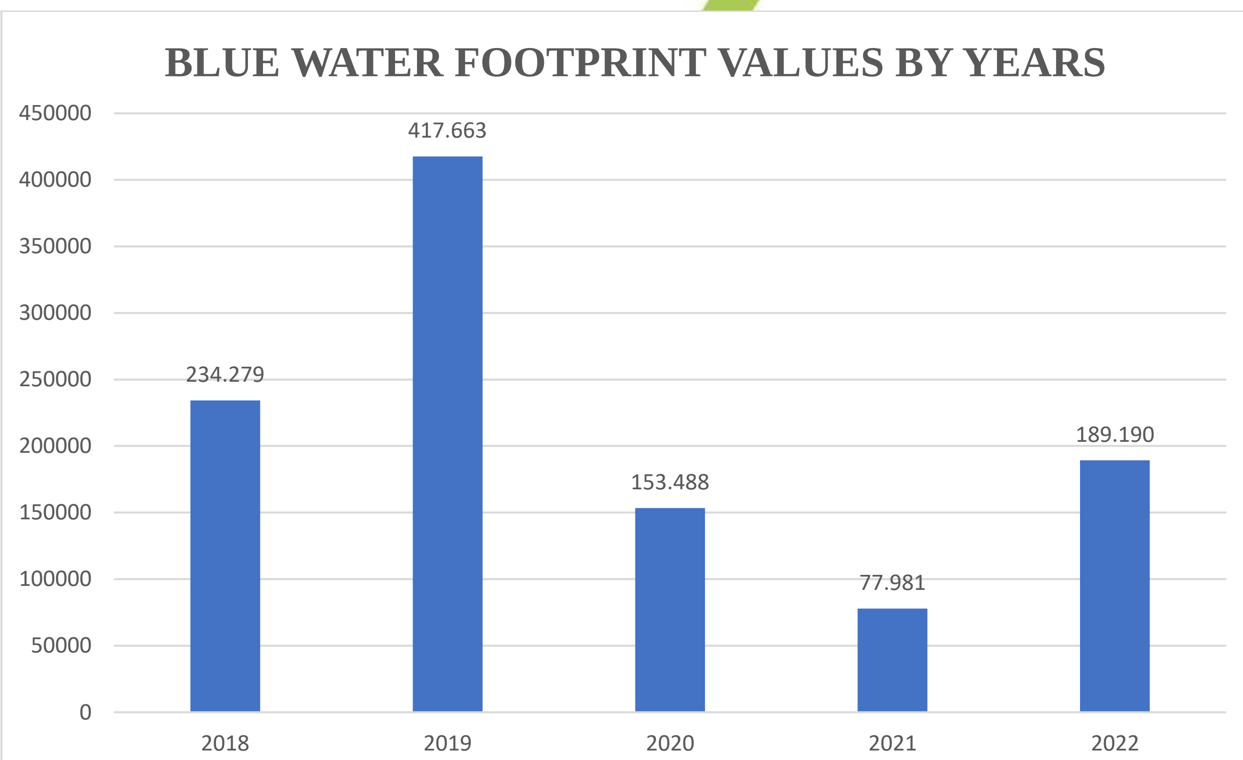


Figure 8. Blue Water Footprint Values By Years

Özyeğin University's annual per capita water consumption (blue water footprint) data were compared against the water footprint study conducted by American University of Beirut and the water footprint profile studies conducted by Istanbul University Cerrahpaşa Avcılar Campus. In this comparison, it is seen that the per-capita water consumption at Özyeğin University stands at 18.9 m3/person, placing it below the average of 58.5 m3/person, as illustrated in Figure 9.

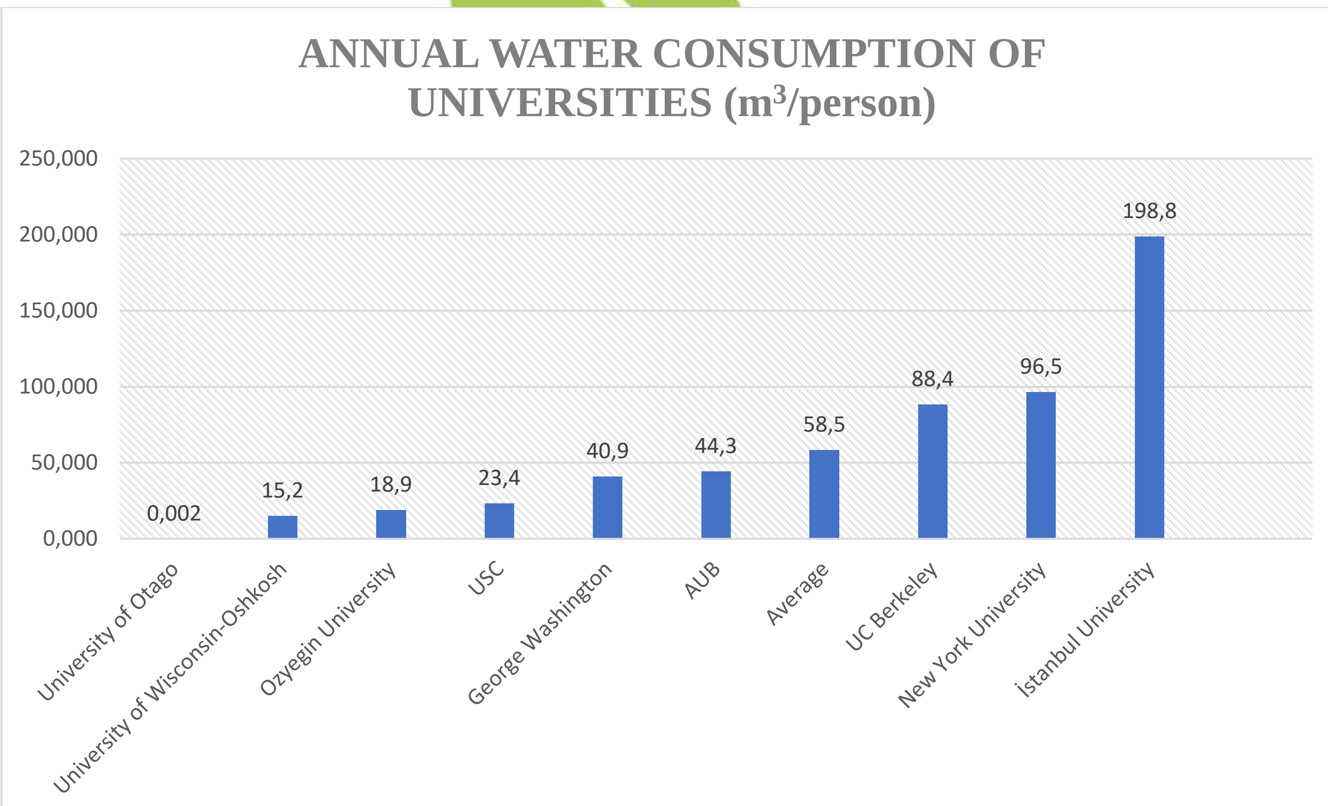


Figure 9. *Annual* Water Consumption Of Universities (m^3/Person)

Özyeğin University forges ahead with unwavering commitment to pioneer new initiatives for efficient management of its water resources, in accordance with principles of environmental awareness and sustainability. To that end, the University has developed new strategies to preserve, save and effectively use its water resources.

The implementation of these strategies has resulted in significant savings in domestic water consumption. While the domestic water consumption rate is approximately 11% worldwide (WWAP 2019), this rate is 16% in Türkiye. Given that the water consumption at Özyeğin

University is predominantly for domestic purposes, the implementation of measures to reduce domestic water consumption would make a significant impact in reducing the institution's water footprint.

1. Water Efficiency Improvement:

Various steps have been taken to improve water efficiency on campus. These steps involve installing aerators that blend air with running water in sinks to enhance flow rate for domestic use, utilizing high-efficiency faucets, implementing sensor systems in sinks, and employing siphons equipped with "Dual Flush" features. Drip irrigation systems are used for garden watering, which effectively curb water evaporation and unnecessary soil saturation. Moreover, water saving is accomplished by selecting climate-appropriate plant species that necessitate minimal water consumption.

2. Rain Water Management

Rainwater collection systems have been installed throughout the campus, and it is encouraged to use this water for a range of purposes including garden irrigation. Thus, this initiative not only resulted in a reduction in the consumption of drinking water but also provided a sustainable water source for irrigation and cleaning purposes.

3. Wastewater Management

Taking actions about the management and recycling of wastewater significantly contributes to enhancing water reusability, thereby reducing the water footprint. Across the campus, recycling systems are employed for grey water such as sink and shower water, and wastewater is recycled to be used in toilet flushes.

4. Green Building and Technologies

The University uses sustainable technologies in building design to promote innovation in water management. To that end, solutions such as water-efficient materials, water-saving irrigation systems, and water recycling systems have been incorporated into the campus.

In conclusion, Özyeğin University attaches great importance to the sustainable and efficient management of water resources with ongoing initiatives contributing to the conservation of water resources within the campus and the wider community. Various strategies are planned for future implementation in this direction.

In addition to these, the following measures can also be implemented:

- Cutting down on shower time can help minimize water consumption. This saves both water and energy.
- Running washing machines and dishwashers at full load saves water as it prevents the need for additional cycles.
- It is important to remember to turn off taps completely when not in use. Leaving the tap running during activities such as brushing teeth or washing dishes may cause unnecessary water loss.
- Leaks in the plumbing within the campus must be detected by regular monitoring and must be promptly repaired. Leaks cause large amounts of water loss in the long run
- Technological solutions should be incorporated into garden irrigation systems to schedule irrigation times.
- Raising awareness about the concept of virtual water is paramount to ensure better understanding of the water used in the production of goods and to save water by avoiding water-intensive products.
- Conducting awareness campaigns to promote water efficiency within the facility can enhance the water-saving practices of faculty, staff, and students.
- Training and awareness programs can be organized for faculty, staff and students to inform them about the importance of water and effective ways to save it. These programs enable more efficient management of water use in daily life.
- By implementing various projects in collaboration with local communities, the government, and other organizations, university campuses can effectively manage their water resources and enhance their water saving.

7. REFERENCES

- ISO 14046:2016 Environmental management —Water footprint — Principles, requirements and Guidelines
- Hoekstra, A. Y., Chapagain, A. K., Aldaya, M. M., & Mekonnen, M. M. (2011). The water footprint assessment manual: Setting the global standard. Routledge.
- https://mevzuat.gov.tr
- Uzun, H. İ. (2012). Riva deresi su kalitesinin belirlenmesi ve istatistiksel analizi (Doctoral dissertation, Sakarya Universitesi (Turkey)).
- GHG Protocol Uncertainty Calculation Tool
- Öztürk, İ. (2017). Atıksu Mühendisliği. İSKİ. https://www.iski.gov.tr/web/assets/SayfalarDocs/e kutuphane/kultur/docs
- https://www.ozyegin.edu.tr/tr
- WWF, (2014). TÜRKİYE'NİN SU AYAK İZİ RAPORU.
- https://www.watercalculator.org/footprint
- https://www.waterfootprint.org/
- https://foodprint.org/blog/plastic-water-bottle
- American University of Beirut (AUB) (2015) AUB's water footprint, environmental health, safety, and riskmanagement. AUB's WATER FOOTPRINT
- Sütırmak, T. (2020). İSTANBUL ÜNİVERSİTESİ - CERRAHPAŞA AVCILAR KAMPÜSÜ SU AYAK İZİ PROFİLİ. https://acikerisim.iuc.edu.tr