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Water Sustainability: Current and Future Challenges at SRM Institute of Science and Technology, Chennai, India

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Abstract SRMIST has healthy approach to sustainability, incorporating social economic and environmental principles that have been in place for nearly a decade implementing short and long-term sustainable objectives. SRMIST developed, maintained the estate, and the surrounding landscape, with due environmental impact and social values and implemented effective, efficient utility management measures, policies and procedures. The 2018/2019 UI Green Metric ranked SRMIST as **9th in India and 392nd in Global Ranking overall and 264th rank globally and 9th rank in India for water parameter and 3rd in the Nation and 243rd globally and 2nd rank nationally and 42nd rank globally for water.** SRM IST improved implementation of the water conservation and recycling program from 75% in 2018 to 95 % in 2019. Water efficient appliances increased > 70% and has a long-term commitment for conservation of water by regularly monitoring the use of water with regular meters. SRMIST has 20 RO plants running 24x7 collecting 31,000L per day for all and installing Ultra Filtration unit. SRMIST's goal is to reduce per capita water consumption varies from 3.7m³ to 3.3m. Among the 4600 M³ waste water generated an average 4140 M³ wastewater is treated and recycled. Rainwater harvesting pits have been constructed in 65% college buildings and hostels is used for the water recharge in the campus and the rainwater stored in the roof tanks are used for toilet flushing.

1. Introduction

SRM IST embed sustainability in the campus, curriculum, community, and culture of the university through the establishment of good leadership and management practices. SEMIST raise sustainability and environmental awareness to promote sound environmentally and ethically responsible behaviors among its stakeholders. SRM IST has a long-term commitment for conservation for water. The Institute of Science and Technology will regularly monitor the use of water with frequent meter readings to enable a rapid response to potential leaks in the system before damage, excessive use and expense occur. Overnight leak tests by taking meter readings before and after a period of no occupancy will

identify any leaks and/or overflows in the building [1].

Sustainability is a priority for many schools and universities, not only to reduce costs, but also for ethical and educational reasons. In recent years, SRMIST focus on the sustainable water and waste management's. Our institute support to reduce the use of water, energy, solid waste and chemicals in and around the university water systems, as well as create solutions that protect surface and ground water. In particular, SRMIST has committed long-term for water conservation. The water management division of the institute has been regularly monitoring the water usage by flow-meter readings, its support to enable a rapid response to potential leaks in the system before damages, excessive use and expense occur. Moreover, reverse osmosis (RO) membrane filters frequently are used to reduce the levels of total dissolved solids and suspended particles for re-usage of treated waste waters. It can be supplied throughout the campus for various purposes (i.e., drinking, cooking, laboratories etc.).

This present paper describes the following objectives, i) Reduce water consumption by 15 % at the end of 2022. ii) Maintain water-consuming equipment at its optimum efficiency in all buildings and facilities. iii) Reduce consumption through tighter control and elimination of leakages. iv) To avoid unnecessary expenditure on water consumption. Moreover, our goal to reduce water consumption per student is near the target, with consumption per student currently at around 3.7 m³. Water use per user including staff and visitors are 3.3 m³. In general, we have made the following methods for conserve the water in the campus such as reduce the unit cost of water, reduce the volume of mains water used, continues water monitoring and an investigate its own sources.

2. Sewage Treatment Plant (STP)

SRM IST is running 3 STP (1, 2.2 and 3.7 MLD) shown in Fig. 1 and one Ultra filtration unit. Water treatment describes industrial-scale processes used to make water more acceptable for the desired end use. The goal of all water treatment processes is to remove existing contaminants in the water or reduce the concentration of such contaminants, so the water becomes fit for its desired end use. The processes involved in treating water for drinking may be solids separation using physical processes such as settling and filtration, and chemical processes such as disinfection and coagulation. The quality of the water treatment process is maintained by certified operators monitoring results of the analytic test performed every four hours and aided by online recording monitors.

The average wastewater generated in the campus is 4600 M³ (or) 46, 00,000 Lit (Fig. 2). The average water treated in the 3 STPs is 4140 M³ (or) 41, 40,000 Lit. The treated water is used for watering the gardens and lawns maintained in the campus as shown in Fig. 3. The sludge settled in the STPs are removed four times a month and composed as manure for the gardens. Thus, the entire wastewater generated in the campus is treated and used for zero discharge. More than 50% of water efficient appliance installed at SRM IST campus.

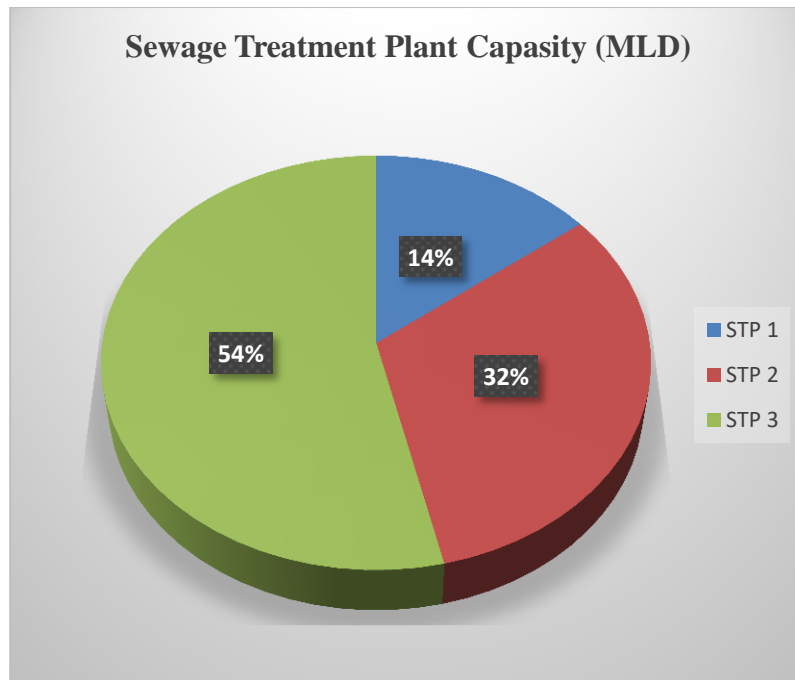


Figure 1. Capacity of STP plant



Figure 2. STP Treatment plant



Figure 3. Treated water used in SRM Campus

3. Rainwater Harvesting

SRM IST capturing rainwater, it can be a valuable way to reduce and aim to eliminate a building's use of municipal potable water, without requiring reductions in water use by occupants. However, it is, of course, more effective in rainy climates than dry ones.

Rooftop Rainwater Harvesting

SRM has initiated and executed the rooftop rainwater harvesting in all the buildings of the Institute of Science and Technology, including hostels, guesthouse and hospitals as shown in Fig. 4. The rainwater collected from building rooftops of buildings connected to a standard header and led to a trickling sand filter. The filtered water is used for domestic purposes after chlorination. Rainwater harvesting is also done by diverting stormwater drains and runoff from rooftops to bore wells for recharge. For this, a pit of size 2m x 2m x 2m is excavated around the dry bore well, and the casing pipe is fitted with a v-wire filter. Filter media is filled in the pit around the well. The stormwater drains and rooftop rainwater are diverted into this pit gets filtered into the borewell through the v-wire filter and the total storage capacity some of 21,07,900 Lit. as shown in Fig. 4 (b).

Rainwater is collected from the roof and stored in large tanks (Fig. 4 (a)). The water is then used for the flushing of toilets and prevents the drinking water from the mains being used. There are many advantages to harvesting rainwater, mainly by providing an independent and local water supply, which is not impacted by regional water restrictions and which reduces the demand on local water infrastructure [2].

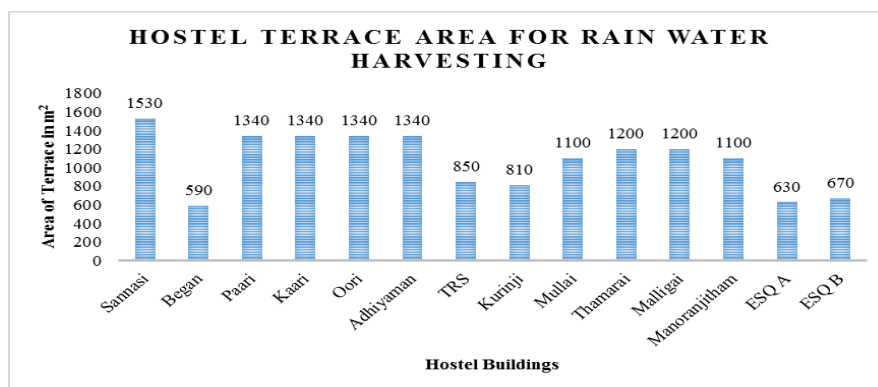


Figure. 4 Hostel Terrace Area for Rain water Harvesting

Rainwater Harvested At SRM IST

The total amount of water received in the form of rainfall over an area is called the rainfall endowment of that area. As per the rainwater harvesting manual prescribed by CPWD. Annual rainfall is 1476 mm, area of roof catchment is 1530 m², and height of rainfall is 1.476m (Table 1 & 2).

Volume of rainfall over the plot = Area of plot x Height of rainfall

Rainwater endowment area of that area = 1530 m² x 1.476 m = 2258.28 m³

Statistically and approximately only effectively harvested water quantity may be considered as = rainwater endowment for that area (A) x 0.8 x surface coefficient = 2258.28 x 0.8 x 0.85 = 1535.64 m³ = 1535640 l

Water Use Reduction in Laboratories & Offices

Recirculate water used for cooling the centralized air-conditioned system. Ensure water-using equipment has as high loadings as possible in the campus. Using water efficiently for cleaning and rinsing and floors. Efficiently used of water baths and heating blocks. Raise awareness of the environmental impact of water usage to the students and staffs.

Water Savings By Rainwater Harvesting In Hostels

The incorporation of RWH system can appreciably tackle the water scarcity problems

Percentage of water saving in hostels = 1535640/3828120 x 100

Over all water saving by hostel roof = 4%

Table 1. Over all achievements in water management

Water type	Total water generated / collected	Water recycled	% of water recycled / Utilized
Waste Water	4600 M ³	4140 M ³	90
Rain Water Harvested	12258 M ³	12258 M ³	100

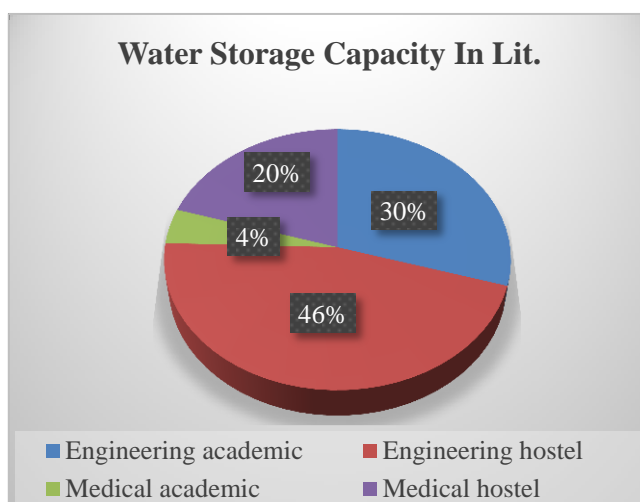


Figure 4 (a). Water Storage capacity

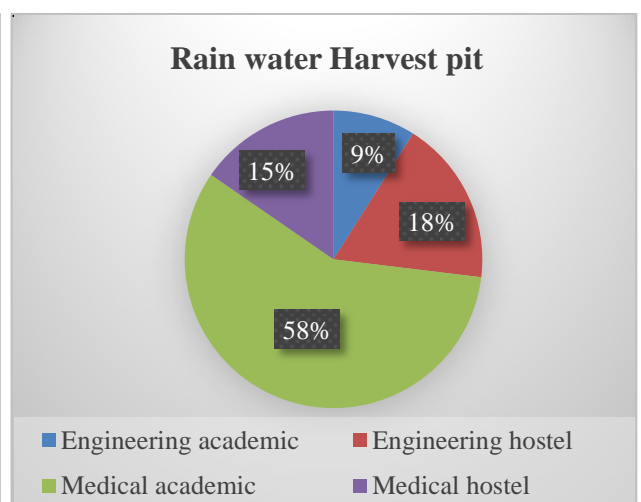


Figure 4 (b). Rain Water Harvest Pit

Table 2. Rainwater harvesting plants at SRMIST

S. No	Campus	Blocks	Number of Rainwater Harvesting	Quantity of Water Collected
1	Annexure Campus	Dental Ground	3	15000
2	Annexure Campus	SRM Hospital	4	15000
3	Annexure Campus	SRM Medical College	2	15000
4	Annexure Campus	SRM PC Roy Hostel	1	15000

4. Reverse Osmosis Plants (R.O. Plants)



Figure 5. Rain Water Harvest Pit at SRM

Reverse osmosis (RO) membrane filters were commonly used for reduces the levels of total dissolved solids and suspended particulate matters were present within water. The membrane configuration is usually cross-flow shown in Fig. 6. The Institute of Science and Technology has provided purified RO drinking water to all the students and staff residing in the campus by setting up the RO plants in the hostels and academic buildings [3]. In addition to drinking purpose, RO water is provided to the hostel mess for cooking foods. Moreover, SRMIST make a special focus on to supply the clean drinking water to the all places in the campus [4]. We also given the projects to student as a water management around the campus. As shown in the figure 7 students are taking the water sample to examine the water parameters in the campus hostels as a final year project. Students collected raw water, RO water and tested in the laboratory for their and checked for suitability of usage.

A total of 30 numbers of RO purification plants were indented in the campus of which 13 numbers for Engineering Hostels, 2 numbers for main campus, 1 number for Green Pearl Apartment, 7 nos for Medical College and other Annexure Campuses respectively (**Table 3**). In which the loading capacity for an average of $1000 \text{ L}^{-\text{hr}}$, the maximum working hours $10 \text{ hr}^{-\text{Day}}$. In recent, the two huge RO units were imported by SRMIST in Engineering Hostels and Medical College for make equalize the excessive need of drinking water, its maximum output capacity was $2000 \text{ L}^{-\text{hr}}$ and the working hours of 8 to $10 \text{ hr}^{-\text{Day}}$. The waste water collected in the separate tank and used for kitchen dish wash and vehicle washing.

Table 3. RO Plants installed at SRMIST

S. No	Campus / Blocks	Total No of R.O units	Capacity	Running Hours	Others
Institution					
1	Main Campus	2 No	1000 L / Hour	10 Hrs	2 x 1000 L
2	Annexure Campus	7 No	1000 L / Hour	10 Hrs	7 x 1000 L
Hostels					
3	Green Pearl Apartment	1 No	1000 L / Hour	10 Hrs	1 x 1000 L
4	Engineering Hostels	13 No	1000 L / Hour and 2000 L / Hour	10 Hrs	12 No = 1000 L 01 No = 2000 L
5	Medical College and Hospital	7 No	1000 L / Hour and 2000 L / Hour	8 to 10 Hours	06 No = 1000 L 01 No = 2000 L



Fig.6. R.O. Plant



Fig.7. Student Project

5. Conclusion

The specification and design of all water systems to monitor frequently by the management staff. While the excellent design of water systems will reduce the amount of water used at SRMIST, the behavior of the students and faculty at the Institute of Science and Technology will carry the most influence. Therefore, occupant education is a crucial

factor in the reduction of water use. Institute of Science and Technology has operated an irrigation monitoring program specifically designed to conserve water and reduce runoff from campus [5]. The irrigation schedule is administered by an advanced automated central control system based upon historical irrigation practices. SRM IST aims to reduce the average wastewater generation by 10% by 2020 and increase the quantity of water to 95 % before 2022 from 90 % in 2016. At SRM we have harvested approximately 12,00,000 Liters of rainwater, our goal is to double the rate of rainwater harvesting by 2022.

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