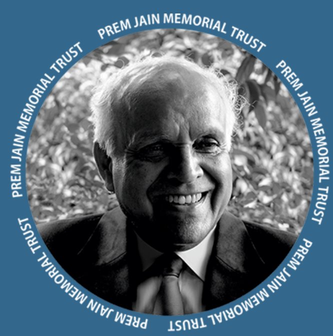
WATER EFFICIENCY IN EDUCATIONAL INSTITUTIONS

TOOLKIT

September 2022



PREM JAIN MEMORIAL TRUST

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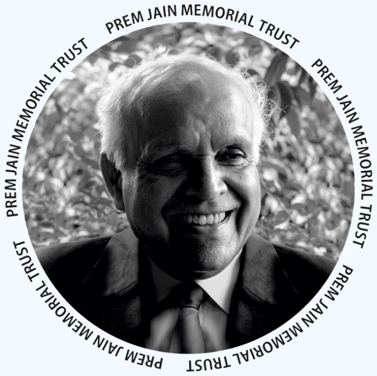

PREM JAIN MEMORIAL TRUST

About
Prem Jain Memorial Trust

Prem Jain Memorial Trust was formed in the year 2018 to continue with the legacy of Dr. Prem C. Jain to promote innovation and sustainability. The mission of Prem Jain Memorial Trust is to create, establish and maintain a sustainability paradigm through education, recognition and nurturing of our present and future generations. The Trust aims at identifying future leaders who can be a catalyst for global development of sustainability and can create awareness and advocacy about the environment. It also wishes to nurture India's young talent by educating and informing them about sustainable development ecosystems.

Dr. Prem Jain, architect of the modern green building movement has ushered in a paradigm shift in the way buildings are conceived and designed worldwide. He has facilitated India stands tall in the global green building movement and aspired for "Bharat to emerge as Jagat Guru in Sustainable Built Environment”.

Dr Prem Jain began to think about Sustainability as a lifestyle way back in the 1970s. Over a half century of dedicated work, he thought and spoke a language that was somehow larger than life, and worked his passion for his ‘Janani Janmabhoomi’ burnt bright through his life’s work and accomplishments. He is also referred to as the 'Father of Green Buildings' in India. The ‘green revolution’ he started is the foundation for the legacy of PJMT, in the hope that we can balance the need for growth and safety of our beautiful planet earth.

Foreword

I am delighted to note that the 'Prem Jain Memorial Trust' is publishing a booklet titled "Water Efficiency in Educational Institutions." This tool kit is a wonderful initiative and effort to bring about a paradigm-shift in the way students think, perceive and view water.

Our country is already water stressed and is facing a looming water bankruptcy. We currently have 17% of the world's population but only 4% of the world's fresh water. India's population is projected to surpass China and will become the most populous country in the next year according to a U.N. Report as the world's population reaches 8 Billion by November, 2022. It is projected that India's population will reach 1.7 Billion in 2050.Already we have a large imbalance in our fresh water and the needs of our population will grow due to various reasons including agriculture and food security, which today takes away 70% of the water, health, hygiene, industry, urbanization (AMRUT 2.0 urbanizing 4,700 cities), the Nal Sae Jal Scheme to provide 30 LPCD to every villager in India, and many other of water's indispensable uses.

Out of the five elements of nature i.e. Jal, Vaayu, Agni, Akash & Dharti, Water (Jal) is most necessary, required, and life supporting element. No living being - flora & fauna, human & animal, micro-organism or bacteria, life under sea or any other form of life, can survive without water. What we do not realize today is what really our water foot print is! A Shortage in water will spell a shortage in food and a shortage in every product that we use, as all products have an embodied water content.

The Tool kit will help the students to be aware of the current water scenario, with water audits, water meters to measure consumption, rain water harvesting, using water efficient products for landscaping and irrigation, treating all waste water and encouraging responsible and apt use of water. I must highlight, that at CII – Indian Green Building Council, we are now envisaging that by 2030, all current buildings and by 2050, all existing buildings must be converted to Net Zero Water, Waste, Energy and Carbon.

There are four pillars to achieve Net Zero Water as given below:

- The most important is Education and Awareness, knowing fully what your water foot print is!
- Use of Low Flow Fixtures and Sanitaryware conforming to 'Water Efficient Product India Guide 2017', published by Indian Plumbing Association or confirming to IS: 16750 Part I & II of Bureau of Indian Standards. Use of any of these codes will save minimum 35% of water at source, without compromising on the comfort of the user, thereby reducing water consumption and the cost of its treatment
- Rain Water Harvesting, either for your own use or to refill the aquifers so that the same water can be used in dry months
- Treating all black and grey water to recycle, reuse and reclaim this water for flushing, gardening, cooling towers and for cleaning purpose

The initiatives to publish the 'Water Efficiency Toolkit' is not only a need of the hour but is a necessity today. I congratulate the team at 'Prem Jain Memorial Trust' on this very necessary and important document.

Gurmit Singh
National Chairman, Cii – Indian Green Building Council
National President, Indian Plumbing Association

Special Message

As Dr. Jain says in his book, Path of Green, , "Bharat is amongst the very few civilizations that called their land-of-birth Janani Janma Bhoomi, Bharat Ma. The soil of Bharat has been considered sacred, something to be preserved with blood and toil. The tradition of 'Aparigraha' permits us to draw from the Earth, only enough resources to sustain a comfortable living.

Water is the elixir of life. Dharti has water and air that sustain all life on our mother earth. Bharat is abundantly blessed with the mighty Himalayas. These are covered with snow round the year. When the snow melts, rivers are born which cascade down the hills and the valleys, and enrich our soil. Nehru in 'The Discovery of India' postulates how all civilizations have grown and decayed near riverbanks. The flowing water in rivers has been a source of drinking water, and the passageway for commuting and for carrying freight to the remotest parts of the country. Therefore, ancient Bharatworshipped the rivers. These were all named after the divine Shakti Goddesses like Ganga, Yamuna, Saraswati, Nila, Kaveri and others. Another blessing for Bharat is the monsoon. It has given birth to classic scriptures like 'Megha duta' by Kalidasa. Seawater evaporates, vapor strikes against the Himalayas and the monsoon arrives, revitalizing our rivers, our sarovers (lakes), our baolees (wells) and our canals. It is estimated that if every drop of rain that falls on Bharat, is harvested, we would be a water surplus nation today and for all tomorrows to come.

My dearest Father believed that 'Youth' is catalyst for 'Change' and for development of sustainability across the globe. His Mission was to nurture young talent, by disseminating education about a sustainable built environment and ecosystems. Prem Jain Memorial Trust works each day to keep this legacy alive and create a Greener Earth, through education, inclusion, advocacy, and it's bright, young students.

At the 3rd Edition of PJMT "World Green Building Week" let us together take a pledge to say "TO CONSERVE WATER EVERY DAY". Let us begin this year with conviction, intention and action to reduce the burden on our Mother Earth.

Payal Jain
Founder Trustee
Prem Jain Memorial Trust

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Introduction

1.1 Overview:

Freshwater is an increasingly scarce resource. Furthermore, freshwater suitable for everyday activities such as drinking, bathing & washing come even more dear. Needless to say, even at many bustling cities across the world, water-scarcity is a source of conflict, tension & all sorts of disturbances. As such, handling water resources efficiently is an obvious pressing need of our times. That way, we can ensure that we abundantly fulfil our water requirements today, while guaranteeing the same for the long-term future.

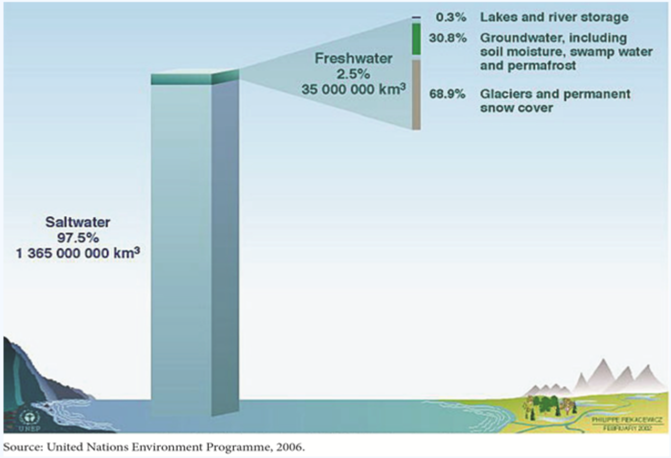


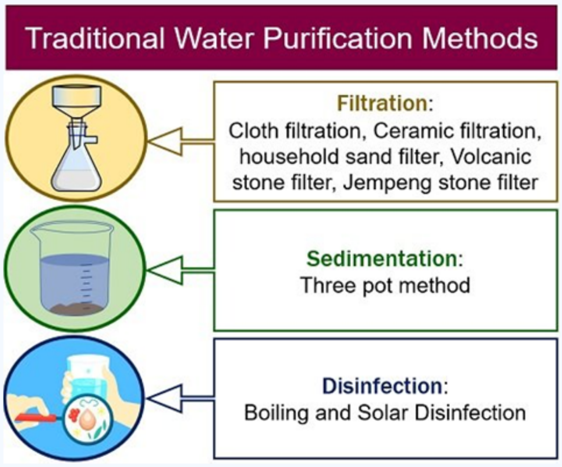
Figure 1: Total Global Freshwater Estimate

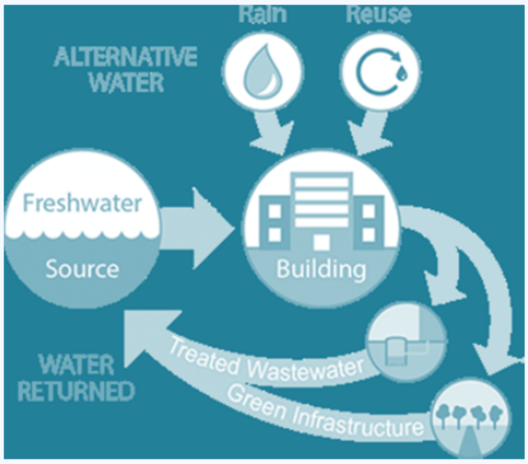
Implementing such water efficiency measures in major educational campuses are apt due to two reasons: their abundant area and their potential as hotbeds for imparting awareness and fledgling ideas. Heeding to this higher calling, PJMT is committed to promote the implementation of such measures, starting with Educational Institutes associated with it. This initiative from PJMT is in line with Dr. Prem Jain's Vision for a Sustainable Lifestyle and as such, is a step towards the former becoming a Catalyst for Global development of Sustainability.

1.2. Water Efficiency vs. Water Conservation:

Minimization of the amount of water used to accomplish a function, task or result is 'Water Efficiency' whereas beneficial reduction in water loss, water or use is 'Water Conservation'. Water efficiency means promoting the sustainable use of water, while using a solution that enables comprehensive reduction in the waste of domestic water.

Implementing water efficient measures makes it possible to sustainability saves on water, energy and costs. While water efficiency and water conservation both promote the responsible use of water, they are two different things.



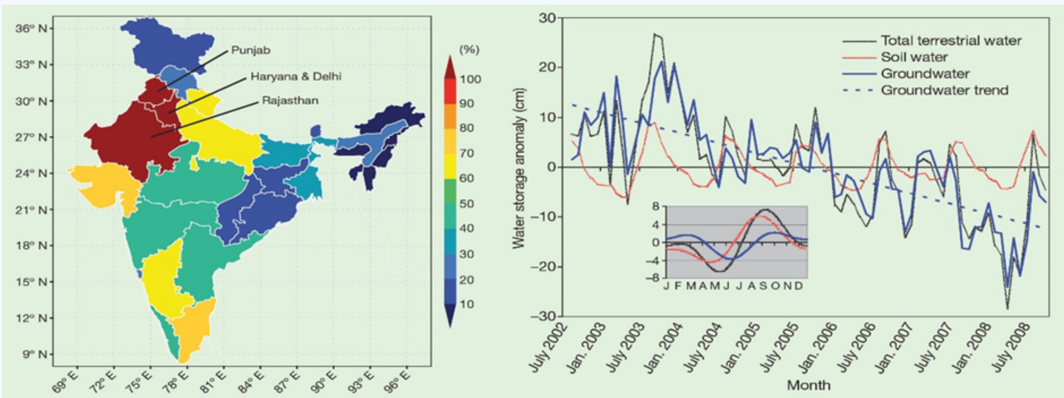


Water conservation is the effort to reduce the direct consumption of water. Everyday examples of water-saving measures in household include turning the tap off while soaping up your hands, showering briefly, and fixing leaks quickly.

Water efficiency means reducing the water used by water function without compromising the comfort and convenience of your water supply. Examples of solution promoting long termwater efficiency are technology that measures water consumption, water saving fittings and property environment certification.

1.3. Current Water Scarcity Scenario:

A study using satellite-based estimation suggests that the groundwater decline in India is severe. Most states in the country are not able to recharge groundwater to even half the levels before extraction. The states of Rajasthan, Haryana and Punjab withdraw almost 100 per cent of the groundwater level after recharge.



Source: M. Rodell et al., 'Satellite Based Estimates of Groundwater Depletion in India', *Nature* 460(7258): 999–1002. September 2009. DOI: 10.1038/nature08238

Figure 2: State-wise Groundwater Withdrawals as Percentage of Recharge

The three states have a semi-arid to arid climate, averaging about 50 cm of annual rainfall. Water Stress refers to the ratio of water drawn to water replenished. In this parameter, lower figures are more desirable. As is evident from the picture, as well as our personal experiences from time to time, Water Scarcity is a pressing issue & India happens to be among the most water-stressed countries in the world. Part of the reason is natural, i.e., simultaneously, certain parts of India experience prolonged droughts while others experience flooding, & vice-versa. Other reasons include increasing population, improving living standards, changing lifestyles/aspirations (eg. Imitating extravaganza), expansion of irrigated agriculture, climate-change, wastage & gross mismanagement.

1.4. Need to Save Water:

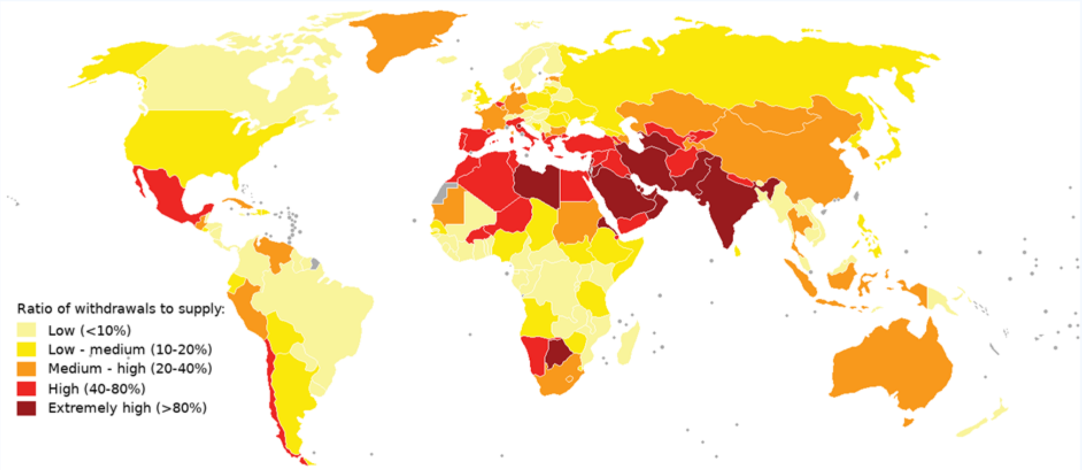


Figure 3: Global Water Stress (2019)

The present Water Stress scenario clearly suggests that fresh, potable water is basically a non-renewable resource, i.e., fresh water is depleting at a rate increasingly greater than that at which it can be replenished. Additionally, India counts as one of the most water-stressed countries in the world. In order to balance such water-availability imbalances across various parts of the country, pragmatic solutions are required. As such, it's only fitting that the Youth of the country be inspired and encouraged to mobilize for this cause. To that end, incorporating such solutions across Educational Campuses across India is a logical step forward.

Physical water scarcity is where there is not enough water to meet all demands, including that needed for ecosystems to function effectively. Arid regions frequently suffer from physical water scarcity.

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Human influence on climate has led to increased water scarcity in areas where water was previously hard to come by. It also occurs where water seems abundant but where resources are over-committed, such as when there is overdevelopment of hydraulic infrastructure, often for irrigation or energy generation. Symptoms of physical water scarcity include severe environmental degradation, such as water pollution, and declining groundwater and water allocations that favor some groups over others.

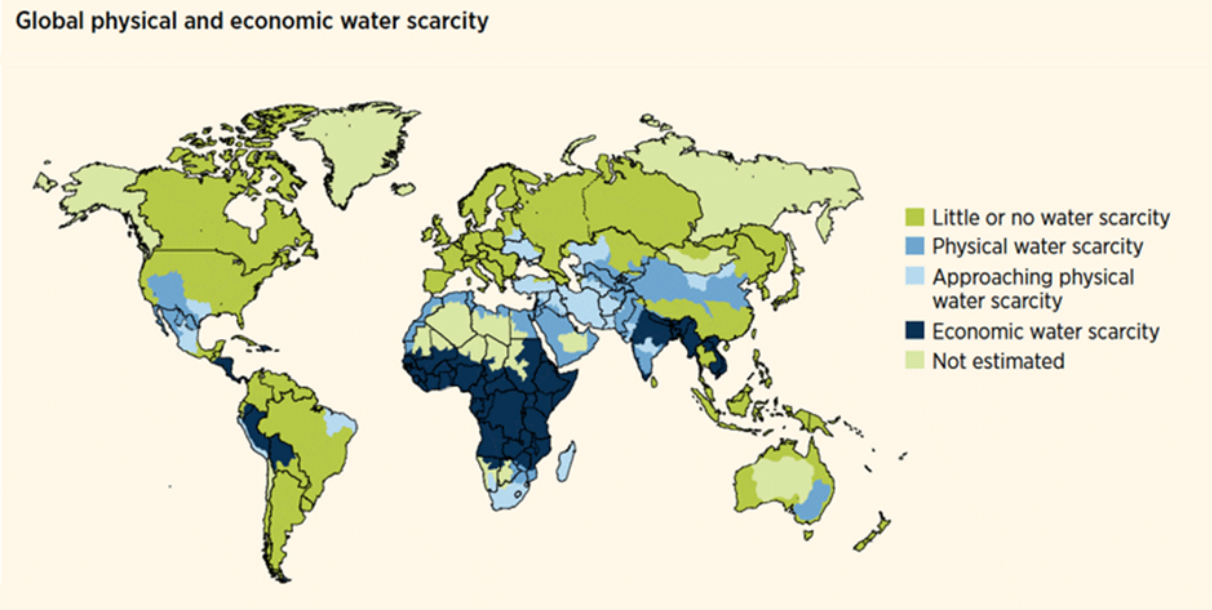

Figure 4: Global Physical and Economic Water Scarcity

Economic water scarcity is caused by a lack of investment in infrastructure or technology to draw water from rivers, aquifers, or other water sources, or insufficient human capacity to satisfy the demand for water. One-quarter of the world's population is affected by economic water scarcity. Economic water scarcity includes a lack of infrastructure, causing the people without reliable access to water to have to travel long distances to fetch water, which is often contaminated from rivers for domestic and agricultural uses (irrigation).
As such, it's only fitting that the Youth of the country be inspired and encouraged to mobilize for this cause. To that end, incorporating such solutions across Educational Campuses across India is a logical step forward.

2
Role of Educational Institutions in Water Conservation

A Sustainable campus programme can open pathways to developing a more environmentally aware and responsible generation of citizens. This can equip resourceful teachers to foster environmental literacy and help every member of the education community to understand the scope and significance of the individual role in sustainable use of resources within the campus. This can encourage the education community to demonstrate and scale up the practice.

Education plays a central role in building professional cadres and knowledge propel the sustainability agenda forward. Transforming places of formal learning - colleges, universities and other large educational institutions - as resource-efficient and low-carbon campuses can demonstrate practice for sustainability.

There is a growing global interest to frame practical strategies for resource savings, conservation and waste reduction to make centres of learning deliver on sustainability indicators and help education community connect with the practical value of sustainable practices that can also have a multiplier effect on the larger society.

The potential of transforming campuses of educational institutions to deliver on sustainability is enormous. As of 2013, India has 45 central universities, 318 state universities, 185 state private universities, 129 deemed to be universities, 55 autonomous institutes of national importance and 37,204 registered colleges. To illustrate, this translates, in terms of energy, into emission of 231 million tonnes of equivalent carbon dioxide (eCO2) per annum approximately.

The need for water, land and biodiversity will be as enormous.If designed and managed well for resource efficiency and sufficiency, these campuses can show how even a city can operate within the limits imposed by finite land, water and energy resources, material, green spaces and biodiversity, and also reduce waste. The education fraternity is large and campuses have substantial physical infrastructure. There are about 3 crore students.

As educational institutions teach, research and do community outreach, they can create multipliers in society to broad base the sustainability agenda. They can also commit resources and create management and planning capacity to enable change.

Above all, to implement anything meaningful, it must be started at the grassroots level & work its way up in the long term. The Educational campuses hence, form the grassroots ground for the implementation of such projects at a larger scale. These campuses nurture the future generation of the country, at the onset of their maturity. As such, conditioning the youth to inculcate & carry such constructive practices forward is a welcome step towards PJMT's vision of Sustainable development.

3
Other Key Benefits

Benefits of water efficiency in educational spaces are manifold in financial, educational, social and environmental ways, stating a few:

- Reduces water and energy costs- Water efficiency reduces water and energy costs thereby reducing greenhouse gas emissions too, meaning that more can be done with the current budget.Also, when carried out in a proper manner, the overall maintenance costs of the campus take a dip as well. Plus, the scope of incurring fines/penalties from water wastage is nullified. This implies lower plumbing maintenance, i.e., lower life-cycle sustainment cost.
- Builds young leaders and provides learning opportunities- Water efficiency activities provide excellent leadership opportunities and practical learning activities for students as well as professional development for the teachers and management staff.
- Community building- Builds a strong college culture based on good communication and shared goals. Getting the whole college involved allows everyone to work together and share successes.
- Raises the institute’s profile and helps gain recognition- When the institute is involved in water efficiency activities it connects with the community through partnerships and local networks. This is increasingly important for the reputation of the institute as students, teachers and parents look for ways to combat climate change and other environmental issues facing our communities.

- Contributes to a better environment through water efficiency-The educational institute will be doing its part in building a better and more sustainable planet now and into the future.Institutes learn to operate more sustainably, reducing costs and minimising their impacton the environment through efficient resource use.
- Adaptability- Educational Institutes create a unique environmental management system and can work with any sustainability resources or organisation to progress through framework.

4
Taking Action

4.1. Water Use Audits:

Water-use audits can be conducted by third-party specialists or by in-house staff who are knowledgeable about water systems. The concept is for the school to get a sense of overall campus-wide water usage. A physical inspection of the property identifies inefficiencies and looks for opportunities to increase water conservation throughout the physical structures on campus.

Conduct a water audit around the campus to understand where and how your institute uses water and what water sources you are currently using. Even without an official student organization, individual students can pair up with faculty and administration officials to put in place larger projects whose goal is to save water.

4.2. Water Metering:

Water metering basically refers to keeping a track on the water-usage within the campus. There are several ways in which this can be carried out. Monitoring the pattern of water consumption & instilling the sense of judicious water usage via passive reinforcement are in this case, the most appropriate measures.

Sub-meters allow you to understand how much water is being used in specific areas of the campus, for example sports center, hostel or science block. Since sub-meters measure more defined parts of the campus they can also help locate leaks. Once we gauge the amount of water used per day, over a prolonged period of time, ideally one year, we obtain an estimate of the total capacity of the project to be implemented.

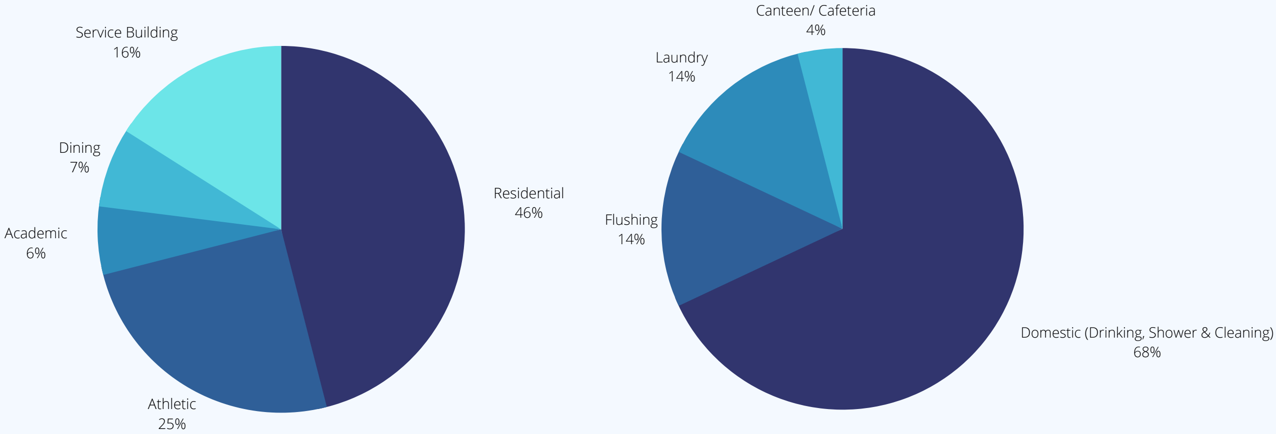

Figure 5: Water Usage in Campus

Studying the pattern of consumption enables the design to adjust to varying consumptions throughout the year, across the seasons. This shall vary according to geography, culture, weather & events taking its toll on any given campus. For example, a campus in the more arid part of Rajasthan is likely to have a modest pattern of consumption. However, if the using population or a good part of it is one that's transplanted from a more water-plenty region, say, New Delhi, the consumption is most likely to spike throughout the pattern. But the Geography dictates that Water be used more judiciously in such semi-arid parts. As such, a balance of these two factors must be struck by inculcation of appropriate behavior of water-consumption among those users who tend to be much more liberal with water usage.

4.3. Rain Water Harvesting:

Rainwater harvesting systems for institutes are great for educating students about the benefits of conservation of our natural resources. They save money by not wasting water, and help to encourage an environmentally responsible attitude in the next generation. With low energy pumps and controls, there are no negatives to using a rainwater system in a campus.

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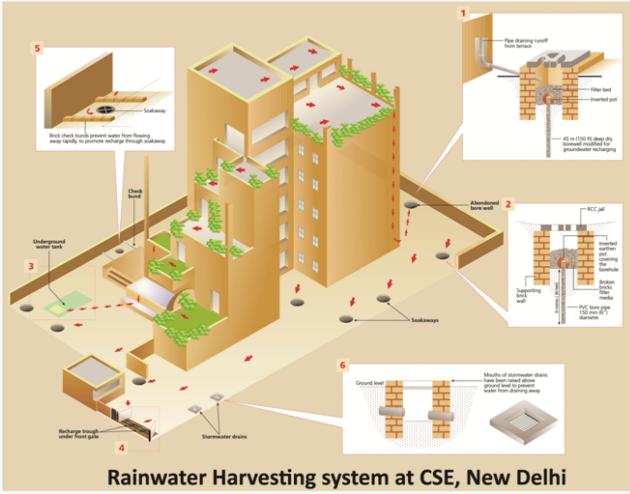


Figure 6: A Typical Modern Rainwater Harvesting Arrangement

The most common practice includes storing rainwater in underground tanks for later use. Also, rainwater can be gathered to create artificial ponds, contributing a pleasant landscape as well as storing clean water for the dry times.

Typical features include rooftop drainage, yard gullies & storm-water drainage. The above illustrated approach is significantly more expensive as it involves the construction of sizeable underground storage tanks & plumbing networks that lead to them, apart from the usual costs of pumping & maintenance.

This green initiative can be further used as a demonstrative project for knowledge dissemination and to create an understanding of sustainability among students within the education program viz., course curriculum, clubs, green fair etc.

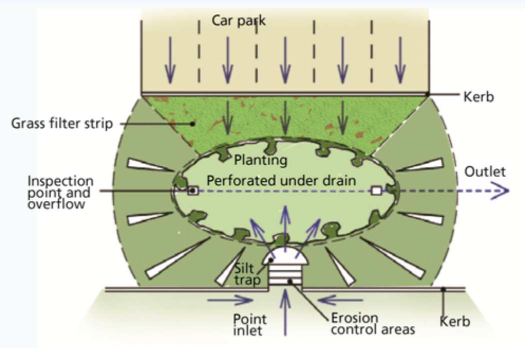


Figure 7: Plan of a Typical Rain Garden

Rainwater harvesting can be carried out on both functional & aesthetic bases. A rain garden is a landscaping approach to rainwater harvesting whereby an artificial water-body is meant to be a catchment area. It stores large quantities of rainwater in the form of surface lakes/ponds. Such water-bodies can be used to significantly enhance the aesthetic qualities of the surrounding landscape & improve campus micro-climate.

Further, local biodiversity namely aquatic flora & fauna flourish & help in naturalizing the artificial water-body. Downsides of rain gardens include loss of water via evaporation, in case of dry weather, & the requirement of large quantity of land, to make room for the surrounding landscape. As such, the wisest approach to rain gardens is to increase its depth, so as to enhance the catchment capacity. However, the best results are obtained when natural water-bodies are present within the campus itself.

4.4. Efficiency Landscaping & Irrigation Practices:

Landscape irrigation practices consume large quantities of potable water, sometimes accounting for 30% to 70%of the water consumed in non-agricultural use. There are various cost-effective active and passive measures that can be applied to implement an effective water-efficiency program within a campus. Some of them are as follows:

Xeriscaping: A drought resistant landscaping example can be provided for students and community members. By increase xeriscaping on campus and decreasing water & energy intensive turfs, landscape water demand can be immensely reduced. Turf will either need to be removed or abandoned in some areas. Identify and prioritize areas on campus that need to remain turf and areas that can be converted to native and drought resistant species as budget and maintenance resources allow.

Figure 8: A Xeriscaping Garden

Educate students about viability of xeriscaping including a xeriscaping workshop for students, faculty, and staff. This resource can be used in plant biology, ecology, engineering, architecture, and ecosystem classes.

Filter Strips: These are simple means to filter particulate impurities such as sand, oil & gravel from the catchment water.

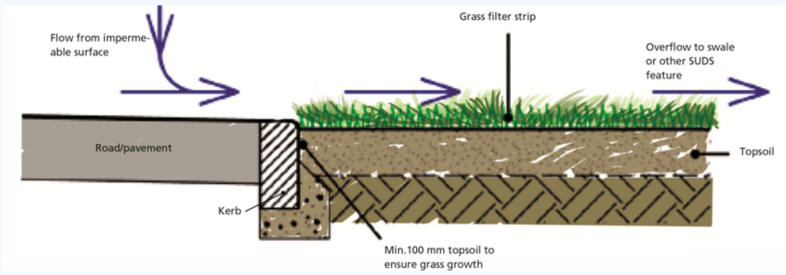


Figure 9: Section of a Filter Strip

Stiff varieties of grass cover gentle slopes of land, which act as mechanical filters for the runoff water. These grass not only appeal aesthetically appealing, but also holds the soil in place, preventing erosion.

Swale: Swales are manmade brooks which are used to facilitate the orderly flow of excess runoff.

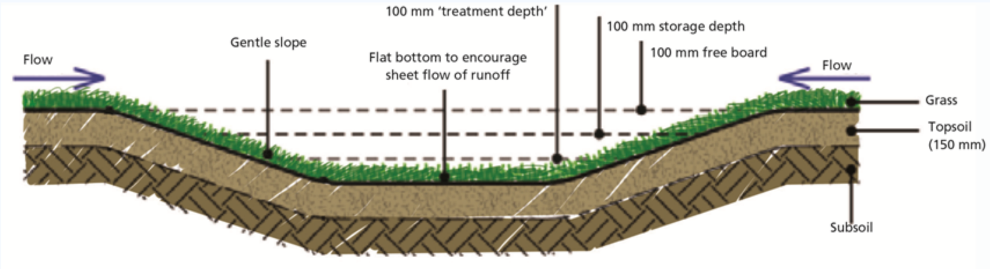


Figure 10: Section of a Swale

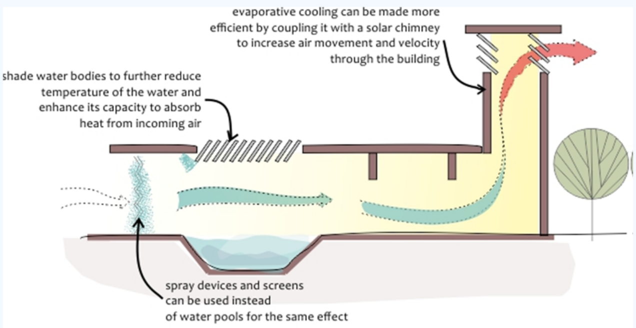
These can be utilized in campuses to drain excess runoff to surrounding community catchment areas.

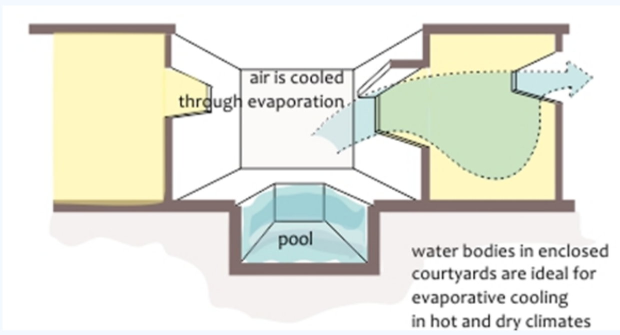
Campus Pool: Campus pools are similar to rain gardens in the inclusion of a water-body as the centerpiece. These are essentially large water-bodies, natural or manmade, designed to serve as the dominating catchment area.

Figure 11: A Campus Pool

Straddling such a water-body, entire functional spaces can be organized, to be as aesthetically appealing as possible. They can support a wide variety of local flora & fauna, thus boosting the local ecosystem. It creates an ambience of stasis & peace to have such a sizeable water-body around and organizing functional spaces around it, something vital to nurturing young minds.
Furthermore, plumbing costs are reduced by drastically cutting down the need of plumbing to draw in from or release into the pool(s). Also, artificial cooling costs are reduced by facilitating a productive micro-climate.
Like rain gardens, campus pools significantly improve the local micro-climate by means of continuous evaporation. Similarly, the deeper the campus pools, greater is its potential as a catchment area.

Climate-Sensitive Architecture:





4.5. Check for Leaks and/ or Blockages:

This is a routine maintenance activity, with or without a water-efficiency program. With Educational campuses, however, the opportunity lies in involving the students to spot anomalies, as Students are often the first people to notice leaks around campus. The practice of reporting leaking faucets, running toilets, faulty hoses, or broken water fountains shall be cultivated into a habit. A single dripping faucet can waste 100 gallons of water a day.

Blockages in plumbing occur mostly due to irresponsible disposal of solid material on plumbing channels. Such instances can be checked by installing mechanical sieves & positive reinforcement of behavior. Reporting leaks and following up to make sure they are fixed is one of the most effective ways individual students can save water at campuses. Area-wise water watching teams can also be formed in order to prevent wastage of water.

4.5. Grey & Black Water Treatment Plant:

Grey Water refers to wastewater from uses such as washing clothes, utensils, bathing, etc. Such water requires some treatment before being potable, as they contain oils, dirt & detergents.

While **Black Water** refers to effluent wastewater from sewage & Industries. It requires extensive, multi-level treatment before being potable. They contain hazardous bacteria, chemicals, heavy metals, greases, dies/pigments, etc.

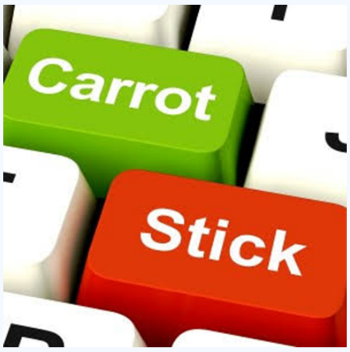
An academic campus is liable to generate both grey and black water in significant quantities. As such, inclusion of an integrated water-treatment facility is vital for an effective water-efficiency program on campus. This is by far, the most expensive component of the entire water-efficiency program in a campus.

This is by far, the most expensive component of the entire water-efficiency program in a campus. However, the capacity depends solely upon forecast, i.e., dependent upon the maximum estimated number of users & the total water usage estimate in a year.

The facility shall be sized to handle the peak treatment requirement, by volume of water used. In many cases, this component can be optional as certain campuses occur within Municipal Jurisdiction, & as such, most likely utilize the public Infrastructure afforded by such Urban Local Bodies. At the end of the day, the purpose of such a treatment plant is to enable the reuse of wastewater for all or most campus purposes.

5
Encouraging Responsible Water Use

5.1. Carrot & Stick Mechanism:



Students & Residential staff alike can be treated according to their individual water usage. For this, every water outlet, let's say, from each hostel room or residential quarter unit must be equipped with individual water meters to track the volume of water drawn over a certain period of time. It can be recommended that a basic level of water shall be drawn as 'quota', from each outlet, without any penalty. Any exceeding volume drawn may be chargeable by per unit volume drawn, to be levied as seen suitable. Conversely, drawing less than the quota volume shall invite Incentives per unit saved, by means such as decrement on hostel/quarter fees, parking charges, electricity bills, etc.

5.2. Contests & Programs:

Evaluations of water consumption may be held every year, whereby similar groups of Campus occupants may be held to compete against each other, so as to encourage minimal water wastage. For example, different hostel blocks may be compared each year in terms of water consumption and overall hygiene, combined together.
The occupants of the block that happens to have least water consumption while meeting set hygiene requirements shall receive benefits such as those mentioned above, at the cost of the others, as well as set the new benchmark(quota) for water consumption for the upcoming year.

Such discriminatory treatment is a means of positive reinforcement towards judicious water usage. One may state it is unjust, but in the long term, it can be argued that such competition shall only diminish wasteful behavior when it comes to water usage. Also, after a time, that benchmark can't go any lower due to its association with set hygiene standards. Given that such an approach is peer-to-peer and not top-down in nature, it is much more pragmatic and readily implementable.
Furthermore, it involves the key stakeholders responsible for the implementation of a water-efficiency program, encouraging collective participation & practical learning.

6
Case Studies

6.1. Case Study 1: Rotary Biological Contractor (RBC) and Water Treatment Plant:

These are fixed-bed reactors made up of stacks of spinning discs set on a horizontal shaft. They are also known as rotating biological filters. As wastewater passes through, they are rotated and partially submerged. After primary sedimentation of household grey- or black water or any other biodegradable effluent, they are employed in typical wastewater treatment plants as secondary treatment.

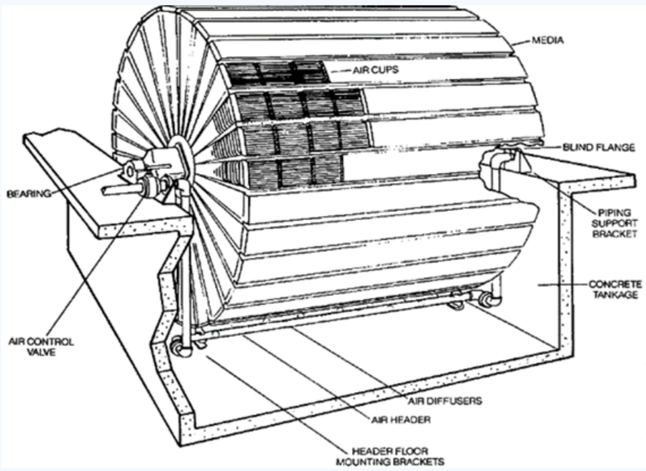


Figure 12: A Rotary Biological Contractor (RBC)

As the microbial community is alternatively exposed to the air and the wastewater, dissolved organic contaminants and nutrients necessary for their breakdown can be aerated and assimilated. It consist of various processes at different level and consist of different equipment. A flow chart of these processes is mentioned below:

The steps involved in RBC are:

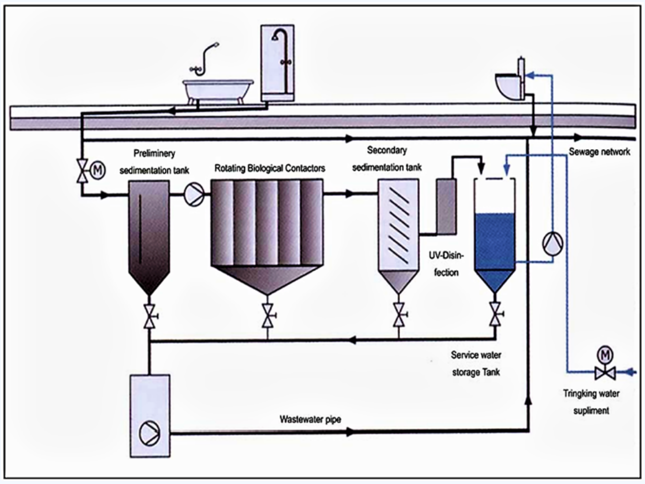
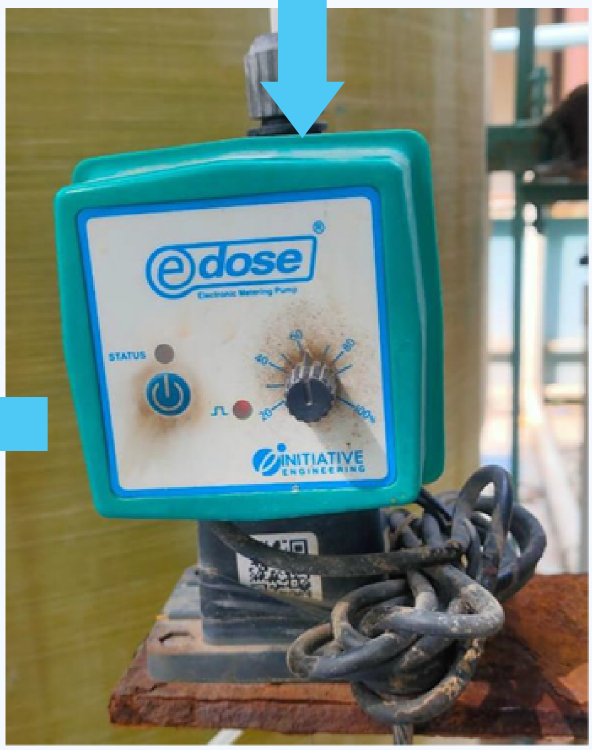


Figure 13: Flow Chart of RBC

- **Water collection from house-holds -** In this process, wastewater is collected from various outlets to be filtered in RBC treatment plant.
- **Screening -** In this process, major impurities are filtered out. This prevents large particles from entering the next stage of the treatment processes.
- **Pre-Sedimentation or Primary Sedimentation tank -** In this section, water is stored in a Sedimentation Tank for settling down of impurities before passing the water on to the RMC Plant.
- RBC plant- RBCs consist of stacks of spinning discs set on a horizontal shaft .As wastewater passes through, they are rotated and partially submerged.
- **Chlorination -** This is a simple process of adding chlorine or chlorine compounds to water. This method is used to eliminate bacteria, viruses and other microbes in the water. Average dose of chlorine added is around 2mg/l.
- **Sand and Carbon Filter -** It's commonly used to remove suspended solids and pathogens that are not removed by the chlori-flocculation process.
- **Backwashing -** It's a process that involves pumping wastewater backwards through filter media, which includes anything placed in a filter that alters the quality of water flowing through it. It's usually attached to a Sand and Carbon filter system.
- **Secondary Sedimentation Tank -** This is the final sedimentation process which consists mainly of 2 sedimentation tanks that help in settling leftover impurities.


Water Inlet through primary Sedimentation


RBC Plant



Chlorination


Sand and Carbon Fliter


Secondary Sedimentation Tank

Treated Wastewater passed on to Storage Tanks

6.2. Case Study 2: IIT, Gandhinagar:

The IIT Gandhinagar campus is the first in India to receive the 5-star GRIHA LD rating for its eco-friendly and sustainable design. The masterplan paid particular attention to preserving natural water bodies, natural landscape and drainage channels as far as possible, and incorporated landscaping strategies and weather-responsive design.

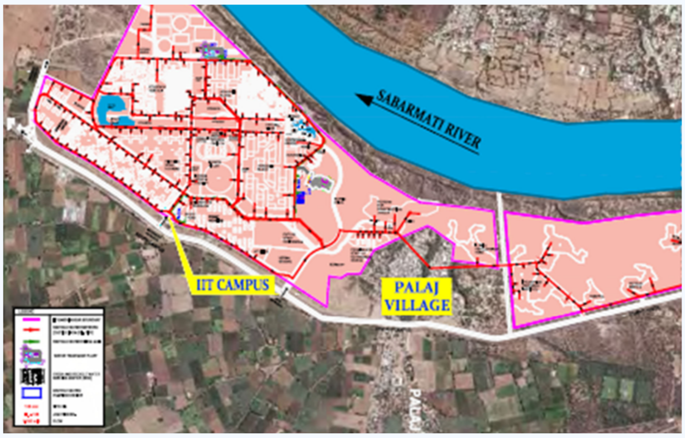


Figure 14: Recycled Water Distribution Network

Being located near river the 450 acres campus still has water crises as Sabarmati River dries up. Most of the water comes from Narmada canal. To solve the water crises the university consists of various methods and techniques in water conservation, purification and efficiency of usage.

- **Sewage Management System:** The campus uses an innovative sewage treatment system called a Decentralized Wastewater Treatment System (DEWATS), which features root zone treatment of the sewage. The resulting treated water is primarily used for irrigation purposes.
- **Use of Modern Fixtures:** In present time people are getting aware of need for water efficiency which became a reason for new fixtures being designed which are making the use of water more efficient. Such fixtures should be used in institutions. These fixtures are Push Taps which minimizes the use of water compared to other taps, Waterless Urinals, etc.

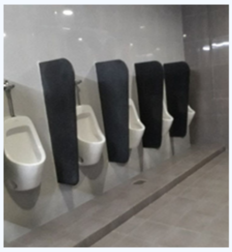


Figure 15: Waterless Urinals


Figure 16: Water Dispenser with Basin

- **Reuse of Water:** The institution has some other prominent uses of water as well which require large amount of water.


Figure 17: Irrigation


Figure 18: Drinking


Figure 19: Sanitary Uses

Figure 20: Fountains

Figure 21: Firefighting

- **Creating Awareness:** Being an educational institution, it is responsibility of each person weather staff or students to minimize the use of water. The water should not be wasted unnecessarily and proper closing of taps should be done after use. Most of campus areas consist of boards and poster which makes the user aware of the need of water and sustainability as an institution is building a leader for future and it's the duty of an institution to make him aware of future crises which can be minimized by efforts of all together.

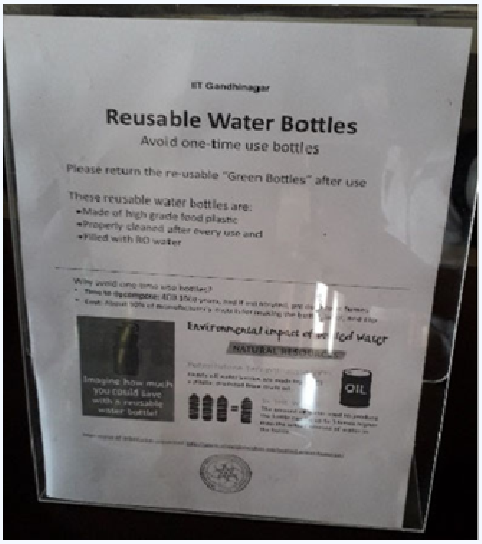


Figure 23: Board for Creating Awareness

- **Other Initiative in Campus:** There are many ways to make the efficient use of water in institutions. The basic ways in efficiency of water usage are:-
  - Check for leakage
  - Proper maintenance
  - Use of proper plumbing fixtures
  - Rainwater Harvesting
  - Water metering
  - Waste water treatment

Conclusion: Through the above study we can conclude that IITGN being in a region where there is scarcity of water not only manages to fulfills its campus need but also distributes the water to the neighboring village through its smart management and distribution of water. The institute uses its sources very efficiently and manages to fulfil all its requirements like drinking, sanitary, washing, cleaning, irrigation, firefighting, etc. The institute has modern systems of water treatment and waste water management. There are also many efficient plumbing fixtures. The campus promotes sustainability and has an eco-friendly environment which is the need for future generation. The campus has set a benchmark for further institutions to be built.

Figure 24: IIT Gandhinagar Campus on the Banks of Sabarmati River

7
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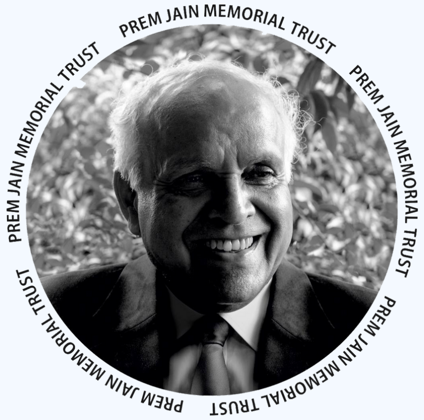

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