Green Initiatives at IIT Jodhpur: A Concept Note

The unique master plan of IIT Jodhpur conceptualizes the workings of all parts of the campus as an interlocking, integral network of complex dynamic systems, like the metabolism of a living organism. This meta-system shall be actively studied and monitored (partly to generate intelligent control instructions and partly to mine data) and in that sense is a settlement evolving through trials and tests, a "Living Laboratory". The ideas for this "Smart Intelligent Eco-campus" encompass the ideals of social, economic and environmental sustainability, and integrate aspects of landscape and biodiversity, food, water and waste, solid waste, mobility, energy and ICT to create an intricate life-like system of campus metabolism.

Fig. Chanakya Complex

Proposed Components of the Green Initiatives

1) Landscape:

Berms act as signature bounding elements containing compact desert settlements. They mitigate noise, dust, heat, and are part of the de-desertification strategy along with green buffer zones, green infrastructure, compact settlement pattern, and east-west streets. This campus is a sustainable oasis in a challenging desert context, providing a protected habitat for flora and fauna (including humans). It rejuvenates the site by providing biodiversity corridors to allow native species to have contiguous habitat and passage across the site and within the region than be isolated in island sanctuaries in a human settlement. The landscape plan aims at minimizing its water requirement using recycled water. The campus uses hardy native species of plants, conserving water and improving soil moisture, while requiring little upkeep and easy disease management.

The landscape is designed to absorb storm water even during extreme rainfall incidents and prevent erosion or flooding. The landscape provides open space for interaction between

students, faculty, local communities, artists, etc. and for art installations and public spaces, and also suitable green cover for parked vehicles.

Action Taken:

a) Rewilding: Institute has also taken up the project of Rewilding of its 06 Hectares of land. Rewilding is a set of interventions to restore the natural ecology of habitats that have been degraded or destroyed. It is about encouraging micro-organisms to re-inhabit degraded soil and bringing back communities of plants that are perfectly adapted to live in particular soil conditions, climate and moisture regime. The Institute is looking to recreate the right conditions by facilitating the natural regeneration of desert plant species, and by reintroducing any such plant species that have disappeared.

b) Wetlands: A CSP Initiative: Wetland creation for the forested landscape was taken up through the CSP initiative. Around 64000 liters of water is now stored in a constructed wetland or pond within the forested landscape. This wetland has a catchment which can hold over 200000 liters of water. These have been constructed using the traditional pond construction knowledge of the local traditional populations. IIT Jodhpur also has a natural wetland which stores the run off of the nearby hill of Ghadav Village, Karwar Block, Jodhpur Rajasthan. The volume of storage available is approximately 1,50,000 litres.

c) SSPV for Trees: A CSP Initiative: Large portions of the land in the campus have contaminated soils. The contaminants of the soils especially excessive salt can be removed using drainage management solutions. Here the soil surface porous vessel (SSPV) volume based technologies recently developed by IITJ are used to enable soil and water management. An area with stunted growth in plants (3000 ft^2), is used to showcase the technology. Approximately around 48000 litres of water is saved for 72 tree sapling every three months with this technology and maintaining a regular growth of the trees.

d) HoLa and SEE: Institute has taken initiatives towards the Campus Sustainability and two areas have been identified namely Horticulture and Landscaping (HoLa) and Society, Energy and Environment (SEE). Under HoLa and SEE various projects have been identified towards Campus Sustainability Programme (CSP) under Centre for Emerging Technology for Sustainable Development (CETSD) in association with Office of Infrastructure.

Under the area HoLa following projects are initiated-

S. No.	Name of Project	Action Taken
1	Development and Maintenance of Horticulture Activity in the Permanent Campus of IIT Jodhpur	The Institute has taken development and maintenance of the horticulture activities of the campus and a total of ~ 800 nos. plants and ~ 1580 nos. hedge were planted last year.
2	Installation of dried wooden plant fibre Mincing Machine	Mincing machine was designed and installed in 2021.
3	Eco-friendly Shed	Thatched roof pathway is to connect Classroom and Faculty block of School of Management & Entrepreneurship.
4	Soil Restoration	Around 75 Sub-surface porous

		vessels were installed to conserve water. On an average 48000 L of water is saved in irrigating around 70 trees during the peak summer months from March to May every year.
5	Solid waste audit in the Campus and segregation at source	Solid waste audit has been done and efforts have been made for waste segregation at source. Twin bin dustbins are installed at multiple locations across the campus and in each building of the campus. Khamba Composters have been installed in Director's Bungalow, Girls Hostels, Faculty guest houses and one Boy's Hostel. Regular clay ceramic ware dust bins to store dry waste was installed at all ATMs on campus and at Office of Infrastructure Engineering

Under the area SEE following projects are initiated-

S. No.	Name of Project	
1	Electrical Vehicle Popularization	Institute has deployed 02 E-Rickshaws and 01 Golf Cart and procurement of 02 Golf Carts/ E buggies is under progress
2	Wetland restoration and design	A large pond with a volume of more than 70,000 liters of water was developed in the forested area of IITJ (Behind the temple on campus). It was constructed using local traditional aspects and use of theory of local traditional knowledge on Talabs.
3	Digital Archiving of Flora and Fauna	Prakriti app has been developed and launched. A photography competition and virtual exhibition to showcase the IITJ campus wildlife was held. Initiated the effort for signing an MoU with ZSI.
4	Carbon Foot print	The institute has carbon emission data for the year 2019-2020 through in-depth evaluation and carbon footprint analysis. This work was performed under guidance of Prof Sudipta Das (Professor of Practice at CETSD) and as a student thesis

		initiative
5	Farmer Market	The nearby villagers were contacted multiple times for providing weekly haat services inside the Institute. However, they were not very keen to come to the Institute.
6	Energy Audit	Energy audit of one of the buildings has been done. Institute has calculated the Energy consumption of Dining Hall Building. The total connected load of the Dining Hall Building is 262.35 kW. The sanction load assume with 60% Diversity Factor= 157.355 kW. Say in kW= 150 kW. The daily consumption of Dining Hall Building is around 2295 kWH.
7	Virtual connection of nearby village with doctors for COVID 19 awareness	Covid 19 Awareness Programs were conducted for Jheepasni, Ghadav villages of Karwar Panchayat and volunteers were trainied to provide medical kits to people affected by CoVID 19.

IIT Jodhpur every year continues CSP projects and undertakes restoration activities of the natural storage available for water. IIT Jodhpur will be one of the most self-sustainable campuses for water availability in the near future.

2) Water:

In this extremely water scarce area, all the roof/ surface runoff is stored in cisterns. The campus can be made a zero water demanding campus by storing all the runoff from areas on the ground in large cisterns so as not to merge with the saline aquifer (which cannot be tapped due to this being located in a distressed zone). Therefore, while a possibility, the targeted zero-water regime is proposed to be modified to create a very low water regime as below.

The water consumption of this campus is reduced notably with efficient fixtures, semi-automated irrigation systems, native plantation, extensive recycling and reuse of sewage, rainwater harvesting, storage and recharge, and encouraging a low water lifestyle.

Taking into account the treated water recharge for some seasons and increased rain water recharge, this campus is a net-zero water campus. Over a period of years, as soil moisture improves and salinity of the aquifer reduces, the remainder white water needs may also be met by ground water, thus making it an autonomous zero-water demanding campus, provided ground water extraction is allowed in the future. The rainfall management system creates a very large storage capacity of roof runoff for water security.

Action Taken:

a) Rain Water Harvesting:-

The Roof top rain water in the Hostels is collected in the underground storage tanks constructed in each hostel. The Capacities of these tanks are 200 kl and 50 kl in 239 seating capacity and 120 seating capacity hostels respectively. The stored water is further utilized for irrigation purposes.

In Academic Buildings and other Residential Buildings, the roof top rain water is discharged in the Swale which carries the water to the pond outside the Campus in nearby village. All the surface run-off water is routed and stored in the pond through swales which connects the entire Campus. The Pond water is utilized by the nearby villages.

Fig. Underground water store tank

b) Domestic Waste Water:-

The Black and Grey Water generated from the Housing Complexes, Academic Buildings and Hostels are treated through De-Centralized anaerobic Waste Water treatment system (DWTS) and recycled. De-Centralized anaerobic waste water treatment system is implemented for sewage treatment of the campus. These are decentralized to cluster of buildings. DWTS provides the benefit of treating the effluent to CPCB discharge standards. DWTS requires semi-skilled/unskilled labour for operation. There are no mechanical parts and thus no energy requirement. These systems are less expensive in capital as well as operational cost. The maintenance costs are also very low. But the space requirements of these systems are on higher side as compared to conventional systems. The DWTS is based on four treatment systems:

- Sedimentation and primary treatment in settlers and septic tanks.
- Secondary Anaerobic Treatment in Baffled Reactors.
- Secondary and tertiary treatment in Planted Gravel Filters.
- Secondary and tertiary treatment in Multi Grade Sand Filters.

Process Diagram of DWTS:

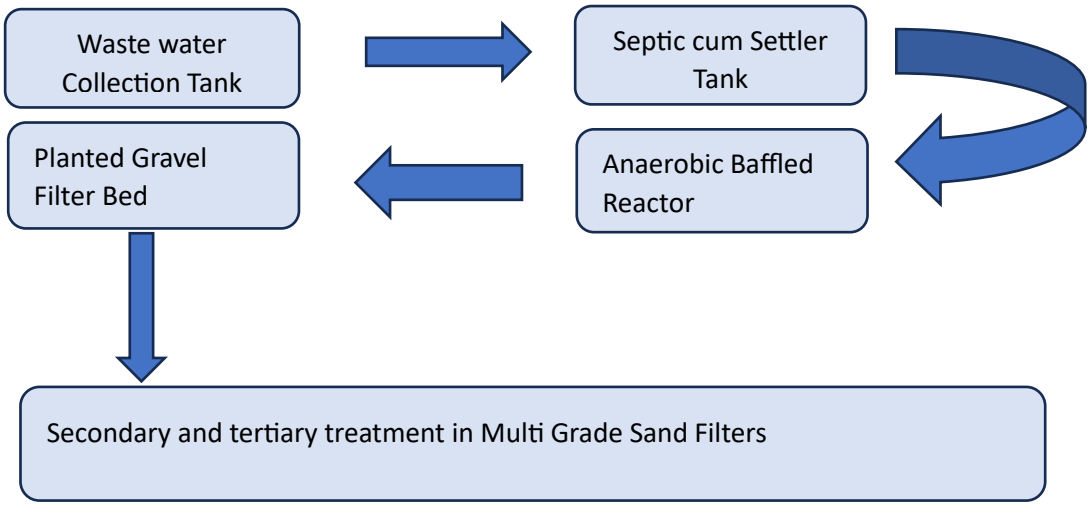

Fig. Decentralised Waste Treatment Plant Bed filter

c) Efficient Fittings and Fixtures-

- The water demand is further reduced by using efficient faucets and fittings;
- Dual Flush system in Water Closets reduces the water consumption; and
- Use of aerator fitted taps and health faucets further reduces water demand.

Fig. Efficient fittings and fixtures

d) Use of Pop-up system and drip irrigation
To water the plant and lawns in the Gardens and sports fields pop-up irrigation system and drip irrigation further reduces the water consumption and ensures effective use of water.


Fig. Irrigation system

Regular awareness guidelines are also issued to the IIT Jodhpur Community from time to time to save water and reduce the wastage of water. Awareness has been first and foremost in water conservation

3) Waste:

This campus will create a zero solid waste regime by segregating waste at source and managing each stream appropriately so the mixed waste for landfill is eliminated.

The campus will create positive value for recyclables such as paper, glass, reusable plastics and metals, isolates hazardous wastes (chemical or biological) for specialized disposal by certified recyclers, and stacks e-waste and the small quantity of mixed waste in stores for specialized disposal by progressively establishing the new Research Cluster for e-waste and mixed waste recycling and increasing this recycling capacity on site.

Action Taken:
A lot of organic waste is generated on the campus primarily from the domestic waste from residences, dining mess and horticulture. Bio-composter of capacity 250 kg/ day waste has been installed. Twin bin dustbins with stand have been placed across the campus and every floor of the Academic as well as Residential buildings. Khamba Composter is being placed at some locations as a pilot project which shall be subsequently increased.
Bio/medical hazardous waste has been collected by concerned agency on regular basis.
It is further planned to collect the garbage door to door for segregation at source. We are aiming to become 'zero-waste campus' by taking steps like processing and disposing of all types of waste sequentially.

4) Energy:

The energy consumption of this campus will reduce notably with passive and traditional techniques of building integrated with renewable energy technologies, with compact building clustering, and by encouraging a low energy lifestyle. The buildings shall be some of the most energy efficient and low resource consuming buildings globally.

The spaces provide adaptive conditioned comfort for nearly all habitable areas while minimizing energy and reducing water.

Action Taken:

a) Orientation and design of the Buildings-

All buildings are aligned in East-West direction to minimize heat radiation through walls. Minimum windows provided on East & West Side walls and Stone Jalis are provided on windows to give shading effect there by reducing the ingress of direct sunlight and reducing the heat load. Use of UPVC windows and Double Glass Units further reduces the heat radiation while allowing enough sun- light. Double walls with thermal insulation (65 mm XPS Board) for all external walls and thermal insulation (XPS Board) on terrace reduces heat load and save electrical energy to the extent of 20%. Height of most of the buildings is restricted to three-four stories and campus surrounded by **Berms** on south West side of 14-15 m height to prevent entry of hot winds in buildings during summers.

b) Light Fittings –

Energy efficient LED and T5 light fittings have been used in all buildings. Street light fixtures are also LED.

c) Roof top Solar Panel -

The Indian Institute of Technology (IIT) Jodhpur has embarked on a remarkable journey towards sustainability by collaborating with NTPC Vidyut Vyapar Nigam (NVVN) for the installation of a 1MW rooftop solar project. This initiative, executed under state net metering regulations, encompasses 14 buildings within the campus, making it one of the largest solar installations in the region. Operating under the Renewable Energy Service Company (RESCO) model, the project brings numerous benefits to IIT Jodhpur and contributes to the institution's long-term environmental goals.

i) Technological Advancements:

The 1MW rooftop solar project at IIT Jodhpur employs cutting-edge technology to optimize solar energy production. Polycrystalline solar panels, known for their efficiency and durability, have been strategically installed on the vacant rooftops across the campus. These panels harness sunlight and convert it into electricity, ensuring a reliable and sustainable energy source for the institution. Furthermore, the project utilizes string MPPT (Maximum Power Point Tracking) technology inverters, which allow for the precise and efficient conversion of solar energy, maximizing the overall power generation potential of the system.

ii) Tariff and Energy Generation:

The tariff for the solar project at IIT Jodhpur is set at an attractive rate of 3.92 Rs per unit. This competitive tariff not only helps IIT Jodhpur reduce its electricity costs but also encourages the adoption of renewable energy sources within the campus. With an average yearly solar generation of approximately 14 lakh units, this 1MW rooftop solar project will significantly contribute to the reduction of greenhouse gas emissions and foster a greener environment.

iii) Benefits and Impact:

The installation of the 1MW rooftop solar project at IIT Jodhpur brings forth numerous benefits and positive impacts. Some of the key advantages include:

iv) Cost Savings:

The project allows IIT Jodhpur to substantially reduce its electricity expenses by harnessing solar energy, which will positively impact the institution's overall budget and financial sustainability.

v) Environmental Footprint:

By relying on clean and renewable solar power, IIT Jodhpur significantly reduces its carbon footprint, contributing to the fight against climate change and promoting sustainable practices.

vi) Research and Education:

The presence of a large-scale solar installation within the campus provides invaluable opportunities for research, innovation, and practical education in the field of renewable energy, fostering a culture of sustainability among students and faculty members.

vii) Energy Independence:

The solar project enhances IIT Jodhpur's energy resilience and independence by generating a substantial portion of its electricity requirements on-site, thereby reducing reliance on conventional energy sources.

To summarize, IIT Jodhpur's 1MW rooftop solar project, installed through a partnership with NVVN under the RESCO model, is a testament to the institution's commitment to sustainability and renewable energy adoption. By taking advantage of state net metering regulations, IIT Jodhpur has not only secured substantial cost savings but also paved the way for a greener and more environmentally conscious campus. This landmark initiative serves as an inspiration to other educational institutions and organizations, highlighting the immense benefits of embracing solar energy for a sustainable future. To add further to it, Institute is planning to extend its roof top solar capacity to additional 1 MW.

Fig. Rooftop Solar Panels

5) Mobility:

The campus segregates motorized, non-motorized vehicles (NMV), and pedestrian movement for a mobility system that provides safety, with better health and quality of life.

It demonstrates a compact development with access to all facilities within a 10 minute walk or cycling trip, and to non-motorized public transport, with adequate parking and external road connections for conventional vehicles.

Action Taken:

As a part of green initiative Institute has deployed e-Rickshaws and EVs for use by the Community. Regular Cycle Sell camps are organised at the beginning of each Academic Year so that the new students joining the Campus can avail the services for their commutation within the huge Campus.

6) Community Engagement:

Traditional building techniques and skills are used to develop the structures. There is a provision for crafts and design workshops with local community, training in modernized local building technologies, taking inspiration from traditional heritage and methods with a fusion of traditional craft and material with futuristic systems. The Institute is engaged in interactive workshops for communicating intentions and outreach projects. On the eve of its Foundation Day i.e. 2nd August every year, the Institute organises mass community plantation.

All the above features make this a near-zero emission campus, planned to provide flexible and phased expansion of all the relevant services.