WATER CONSERVATION INITIATIVES REPORT

Shoolini University

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1. Introduction

In an era marked by increasing environmental challenges and concerns, institutions dedicated to higher education and research are playing a pivotal role in addressing the world's pressing issues. Shoolini University, situated amidst the picturesque hills, has emerged as a beacon of sustainable development and innovation, particularly in the realm of water management. This report sheds light on Shoolini University's unwavering commitment to the United Nations Sustainable Development Goals, with a specific focus on water conservation and clean water sanitation.

Water, often referred to as the elixir of life, is a resource of paramount importance. Shoolini University recognizes this fact and has taken substantial strides towards ensuring equitable access to clean water and sustainable water management practices, both within its campus and in the surrounding communities. With a total peak residential population of 5,500 individuals, including students and staff, and a floating population of 1,000 persons, the university has made it a priority to minimize water consumption, treat wastewater effectively, and promote water conservation through a multi-pronged approach.

This report will delve into the university's initiatives, achievements, and ongoing research in the field of water management. From its state-of-the-art Sewage Treatment Plant (STP) utilizing biological and tertiary treatment technologies to its pioneering efforts in rainwater harvesting, Shoolini University has become a shining example of sustainable water management practices.

Moreover, the university's commitment extends beyond its campus borders. Shoolini University actively engages with local communities, collaborating with government bodies and non-governmental organizations (NGOs) to address water pollution issues and raise awareness about responsible water usage. These partnerships have garnered substantial funding for research projects aimed at finding sustainable solutions to water-related challenges.

In this report, we will explore the various facets of Shoolini University's water management endeavors, including its educational programs, cutting-edge research in water treatment technologies, collaborations with government agencies and NGOs, and extensive outreach efforts. Through its dedication to achieving the UN SDGs and its innovative approach to water management, Shoolini University stands as a testament to the transformative power of education and research in safeguarding our planet's most precious resource: water

Impact Rankings 2022: clean water and sanitation

The *Times Higher Education* Impact Rankings are the only global performance tables that assess universities against the United Nations' Sustainable Development Goals (SDGs). We use carefully calibrated indicators to provide comprehensive and balanced comparison across four broad areas: research, stewardship, outreach and teaching

This table on **SDG 6 – clean water and sanitation** measures universities' research related to water, their water usage and their commitment to ensuring good water management in the wider community.

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2022

How to get your uni ranked

EXPLORE IMPACT RANKINGS FOR INDIVIDUAL SDGS

OVERALL RANKING | 1 NO POVERTY | 2 ZERO HUNGER | 3 GOOD HEALTH AND WELL-BEING | 4 QUALITY EDUCATION | 5 GENDER EQUALITY | 6 CLEAN WATER AND SANITATION | 7 AFFORDABLE AND CLEAN ENERGY | 8 DECENT WORK AND ECONOMIC GROWTH | 9 INDUSTRY INNOVATION AND INFRASTRUCTURE | 10 REDUCED INEQUALITIES | 11 SUSTAINABLE CITIES AND COMMUNITIES | 12 RESPONSIBLE CONSUMPTION AND PRODUCTION | 13 CLIMATE ACTION | 14 LIFE BELOW WATER | 15 LIFE ON LAND | 16 PEACE, JUSTICE AND STRONG INSTITUTIONS | 17 PARTNERSHIPS FOR THE GOALS

Rank	Name	Clean water and sanitation	Overall
1	Western Sydney University Australia	90.0	99.1
2	University of Technology Sydney Australia	89.7	95.6
3	Ain Shams University Egypt	89.4	82.1–88.5
4	Al-Ahliyya Amman University Jordan Explore	88.8	82.1–88.5
5	University of the Sunshine Coast Australia	87.0	93.6
6	Shoolini University of Biotechnology and Management Sciences India	86.6	82.1–88.5

Shoolini University ranked 6th Globally in SDG 6- Clean Water and Sanitation in 2022

2. Water conservation initiatives:

At the core of our endeavours lies a resolute commitment to sustainability. Shoolini University systematically addresses the challenges posed by clean water and sanitation. Our approach is rooted in continuous monitoring and assessment of various parameters, including:

Total Water Inflow: We meticulously calculate the total inflow of water from diverse sources, amounting to 290 m3D from three resources i.e., six bore wells (160 KLD), IPH water supply (100 KLD), and Spring water supply (30 KLD).
Per Capita Water Consumption: We closely track water consumption on a per-person basis, which stands at 400 KLD (57.14 Lts./person).
Resource Diversification: We evaluate the supply of total water from various sources to ensure efficient utilization.

2.1 Rainwater harvesting

Rainwater harvesting is an essential and sustainable practice that has been implemented in the area surrounding the university campus. This method involves collecting and storing rainwater for various beneficial purposes, contributing to both water conservation and environmental sustainability.

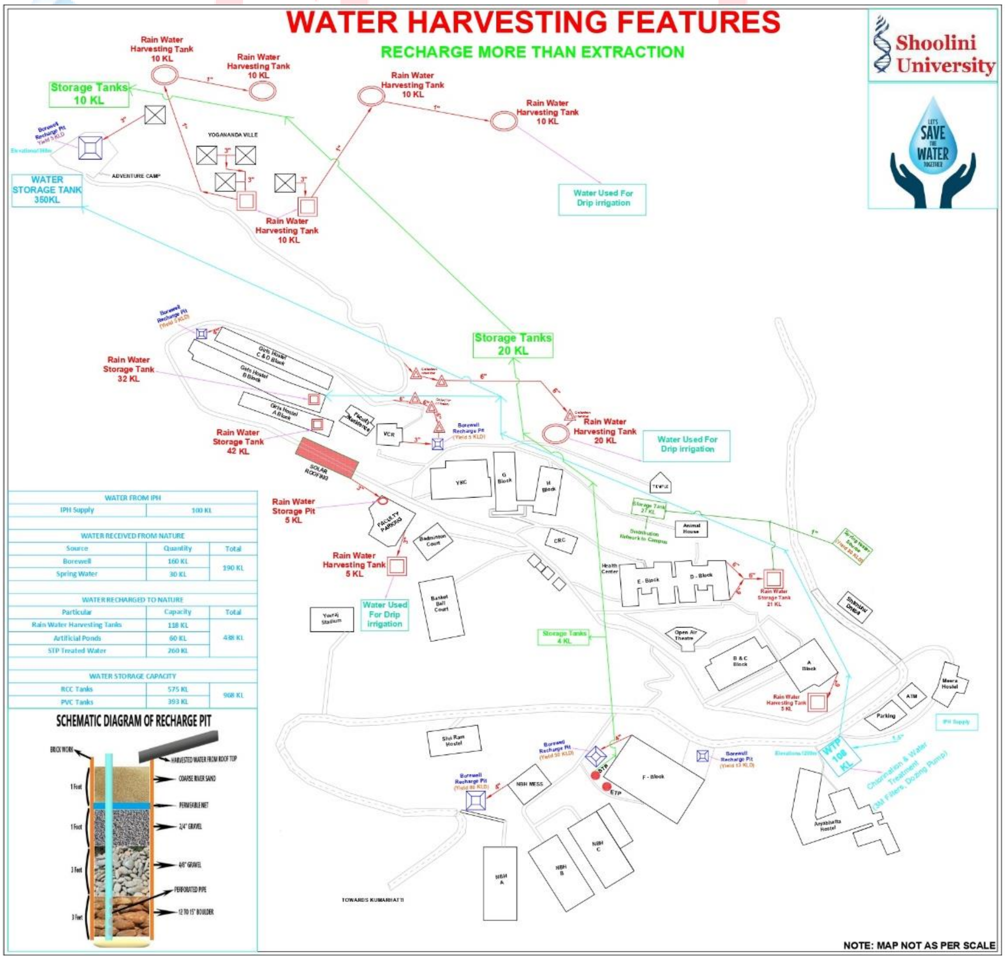


Figure 1: Rainwater harvesting features.

Figure 2: A rainwater collection chamber

Purpose of Rainwater Harvesting: The primary goal of rainwater harvesting in the vicinity of the university campus is to manage water resources efficiently and reduce the dependency on traditional water sources like bore wells or municipal water supply.

Collection Mechanisms: Rainwater is collected from different sources, mainly rooftops, and roadside drains. The campus's infrastructure is equipped with rainwater harvesting tanks strategically placed to capture rainwater runoff. These tanks are designed to hold significant volumes of rainwater.

Multiple Uses: The harvested rainwater serves various purposes. One of the main applications is for landscaping. It can be used to water gardens, lawns, and green spaces on the university campus. This not only conserves water but also promotes a lush and sustainable environment.

Off-Campus Initiatives: In addition to on-campus efforts, the university extends its commitment to water conservation beyond its immediate surroundings. The reference to "camps off the campus" suggests that the institution actively engages in off-site activities focused on cleaning and conserving water resources in neighboring areas. This demonstrates a broader commitment to environmental stewardship.
The adoption of rainwater harvesting practices in the university's vicinity is a multi-faceted approach to water conservation and sustainability.

SCAN ME

Scan to read Water Conservation and Reuse policy.

Figure 3: Plant propagation chamber

Recharging Bore Well Pits: Another important aspect of rainwater harvesting is the recharging of bore well pits. By replenishing groundwater through this method, the university contributes to maintaining the local water table and ensuring a sustainable supply of groundwater.

Figure 4: Borewells

2.2 Sewage treatment plant

Shoolini University's Sewage Treatment Plant (STP), with a capacity of 550 KLD, employs a dual approach to wastewater treatment. Initially, the Activated Sludge Process utilizes microorganisms in a bioreactor to break down organic pollutants, producing nutrient-rich sludge. Subsequently, the effluent undergoes tertiary treatment through pressure filters containing sand and activated carbon to remove any remaining impurities. For complete disinfection, sodium hypochlorite is used, ensuring the removal of harmful bacteria and pathogens. The treated water is then effectively repurposed for irrigation in horticulture, garden maintenance, and construction work on campus, promoting sustainable water management and responsible environmental practices.

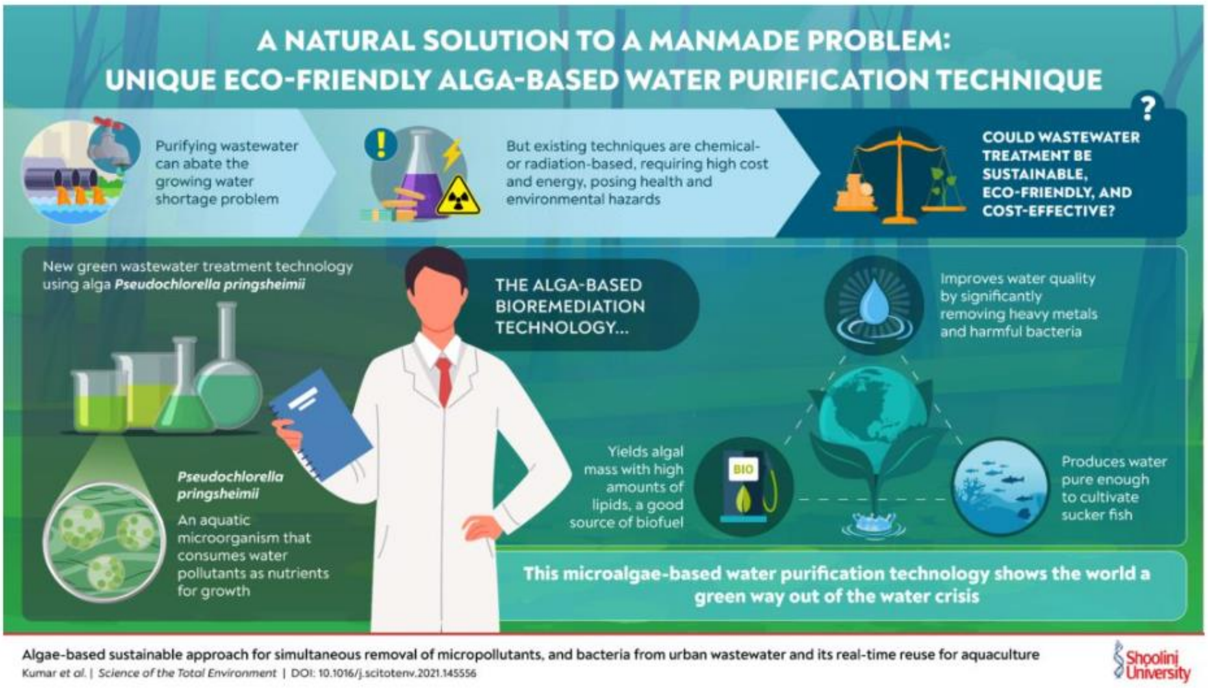
Figure 5: Sewage treatment plant

2.3 Drought-tolerant plants

The campus has implemented a highly successful model for landscape plantations, emphasizing the strategic use of drought-tolerant plants. Drought-tolerant plants are species that have adapted to thrive in arid or water-scarce conditions, making them an excellent choice for landscaping in regions prone to water scarcity or where water conservation is a priority. The primary goal of this model is to minimize water usage for landscaping purposes. Traditional landscapes often require substantial irrigation, leading to excessive water consumption, especially in areas with limited water resources. By introducing drought-tolerant plants, the campus significantly reduces its reliance on irrigation, contributing to water conservation efforts. Drought-tolerant plants are selected for their ability to withstand prolonged periods of limited rainfall or drought conditions. As a result, they require significantly less water to thrive compared to non-drought-tolerant species. This not only conserves water but also reduces the environmental impact associated with excessive water use.

Figure 6: Landscape below Cancer Research Centre

Green and Clean: New Eco-friendly and Sustainable Algae-Based Way to Fight Water Pollution



A team of scientists from India (Algae Research and Bioenergy Lab, Uttaranchal University; Faculty of Applied Sciences and Biotechnology, Shoolini University; and Department of Biotechnology, Dolphin (P.G.) Institute of Biomedical and Natural Sciences), Korea (Department of Environmental Engineering, The University of Seoul), and Russia (Joint Institute for High Temperatures of the Russian Academy of Sciences and Department of Environmental Monitoring and Forecasting, RUDN University), **led by Dr. Pankaj Kumar Chauhan from Shoolini University,** have developed wastewater treatment technology based on algal bioremediation. Their study is published in Science of the Total Environment. This new technology is a remarkable success in eco-friendly wastewater treatment research and highlights the suitability of using treated water for low-cost fish cultivation. Dr. Chauhan is hopeful that their microalgae-based bioremediation technique will pave the way for a greener and more sustainable future.

Authors	Vinod Kumar f,g, Krishna Kumar Jaiswal a, Monu Verma b,f, Mikhail S. Vlaskin c, Manisha Nanda d, Pankaj Kumar Chauhan e, Ajay Singh a, Hyunook Kimb
Title of the original paper	Algae-based sustainable approach for the simultaneous removal of micropollutants, and bacteria from urban wastewater and its real-time reuse for aquaculture.
Journal	Science of the Total Environment
DOI	https://doi.org/10.1016/j.scitotenv.2021.145556

3. Research and Publications:

As a research-driven institution committed to sustainability, our university places a strong emphasis on the development of environmentally conscious research technologies. At Shoolini University, we offer a comprehensive three-year Ph.D. program in Water Management, encompassing a wide range of topics such as hydrogeology, marine hydrology, drainage basin management, water quality, irrigation, water conservation, and water treatment. Our scholars enjoy abundant opportunities to conduct impactful research, collaborating closely with environmental engineers, geologists, and civil engineers.

Water management professionals are at the forefront of addressing pressing global challenges such as climate change and the preservation of water resources. The ever-increasing demand for freshwater has led to the rapid depletion of its sources, prompting scientists to explore strategies for wastewater purification and reuse to meet future demands. While conventional wastewater treatment techniques rely on chemicals or ultraviolet radiation to eliminate microorganisms and pollutants, these methods have drawbacks, including health concerns related to chemical substances and high energy requirements for treatment facilities.

To establish a sustainable wastewater treatment system, there is a growing shift towards eco-friendly and cost-effective technologies. One such technology is photocatalysis, which harnesses readily available solar light and semiconducting materials as catalysts to treat a wide range of organic and inorganic pollutants, as well as microorganisms. Several researchers at Shoolini University are dedicated to advancing the potential of this technology from laboratory-scale experiments to pilot-scale applications, consistently generating high-impact research publications in the process.
Doctorate program in Water Management -
https://shooliniuniversity.com/phd-water-management

Publications:
Shoolini University has made significant strides in the field of water conservation and management, as evidenced by its impressive record of publications. According to Scopus Data, the university has demonstrated substantial contributions in the areas of water treatment and related water management. With a remarkable total of 833 publications associated with the keyword "water treatment," Shoolini University has been actively engaged in cutting-edge research and dissemination of knowledge in this critical domain. These publications encompass a wide range of topics, including innovative wastewater treatment technologies, sustainable water management strategies, and eco-friendly approaches to address water quality issues. The university's commitment to advancing research in water conservation is clearly reflected in its extensive body of work, making it a notable contributor to the global efforts to protect and preserve our precious water resources.

Table 1: List of a few publications

S. No.	Title	Authors
1	Applications of artificial intelligence in water treatment for optimization and automation of adsorption processes: Recent advances and prospects	Alam, G.| Ihsanullah, I.| Naushad, M.| Sillanpää, M.
2	Simultaneous Dual-Functional Photocatalysis by g-C3N4-Based Nanostructures	Akhundi, A.| Zaker Moshfegh, A.| Habibi-Yangjeh, A.| Sillanpää, M.
3	Cellulosic biomass-based sustainable hydrogels for wastewater remediation: Chemistry and prospective	Thakur, S.| Verma, A.| Kumar, V.| Jin Yang, X.| Krishnamurthy, S.| Coulon, F.| Thakur, V.K.
4	Wave height predictions in complex sea flow through soft-computing models: A case study of Persian Gulf	Sadeghifar, T.| Lama, G.F.C.| Sihag, P.| Bayram, A.| Kisi, O.
5	Hydroxyapatite tailored hierarchical porous biochar composite immobilized Cd(II) and Pb(II) and mitigated their hazardous effects in contaminated water and soil	Wu, W.| Liu, Z.| Azeem, M.| Guo, Z.| Li, R.| Li, Y.| Peng, Y.| Ali, E.F.| Wang, H.| Wang, S.| Rinklebe, J.| Shaheen, S.M.| Zhang, Z.
6	Efficient dye degradation strategies using green synthesized ZnO-based nanoplatforms: A review	Batra, V.| Kaur, I.| Pathania, D.| Sonu| Chaudhary, V.
7	Prism-like integrated Bi2WO6 with Ag-CuBi2O4 on carbon nanotubes (CNTs) as an efficient and robust S-scheme interfacial charge transfer photocatalyst for the removal of organic pollutants from wastewater	Dutta, V.| Sonu, S.| Raizada, P.| Thakur, V.K.| Ahamad, T.| Thakur, S.| Kumar Verma, P.| Quang, H.H.P.| Nguyen, V.-H.| Singh, P.
8	Bentonite-based sodium alginate/ dextrin cross-linked poly (acrylic acid) hydrogel nanohybrids for facile removal of paraquat herbicide from aqueous solutions	Thakur, S.| Verma, A.| Raizada, P.| Gunduz, O.| Janas, D.| Alsanie, W.F.| Scarpa, F.| Thakur, V.K.
9	Removal of nanoplastics in water treatment processes: A review	Keerthana Devi, M.| Karmegam, N.| Manikandan, S.| Subbaiya, R.| Song, H.| Kwon, E.E.| Sarkar, B.| Bolan, N.| Kim, W.| Rinklebe, J.| Govarthanan, M.
10	Recent advances in hydrochar application for the adsorptive removal of wastewater pollutants	Ighalo, J.O.| Rangabhashiyam, S.| Dulta, K.| Umeh, C.T.| Iwuozor, K.O.| Aniagor, C.O.| Eshiemogie, S.O.| Iwuchukwu, F.U.| Igwegbe, C.A.

11	Copper sulfides based photocatalysts for degradation of environmental pollution hazards: A review on the recent catalyst design concepts and future perspectives	Sudhaik, A.| Raizada, P.| Rangabhashiyam, S.| Singh, A.| Nguyen, V.-H.| Van Le, Q.| Khan, A.A.P.| Hu, C.| Huang, C.-W.| Ahamad, T.| Singh, P.
12	Production and harvesting of microalgae and an efficient operational approach to biofuel production for a sustainable environment	Khan, S.| Naushad, M.| Iqbal, J.| Bathula, C.| Sharma, G.
13	Photocatalytic Degradation Properties of Li-Cr Ions Substituted $CoFe_2O_4$ Nanoparticles for Wastewater Treatment Application	Kalia, R.| Chauhan, A.| Verma, R.| Sharma, M.| Batoo, K.M.| Kumar, R.| Hussain, S.| Ghotekar, S.| Ijaz, M.F.
14	Adsorption of persistent organic pollutants (POPs) from the aqueous environment by nano-adsorbents: A review	Ighalo, J.O.| Yap, P.-S.| Iwuozor, K.O.| Aniagor, C.O.| Liu, T.| Dulta, K.| Iwuchukwu, F.U.| Rangabhashiyam, S.
15	Remediation of Cd and Cu contaminated water and soil using novel nanomaterials derived from sugar beet processing- and clay brick factory-solid wastes	Lashen, Z.M.| Shams, M.S.| El-Sheshtawy, H.S.| Slaný, M.| Antoniadis, V.| Yang, X.| Sharma, G.| Rinklebe, J.| Shaheen, S.M.| Elmahdy, S.M.
16	Metallic nanoparticles for catalytic reduction of toxic hexavalent chromium from aqueous medium: A state-of-the-art review	Bashir, M.S.| Ramzan, N.| Najam, T.| Abbas, G.| Gu, X.| Arif, M.| Qasim, M.| Bashir, H.| Shah, S.S.A.| Sillanpää, M.
17	Synthetic organic antibiotics residues as emerging contaminants waste-to-resources processing for a circular economy in China: Challenges and perspective	Zhou, Y.| Li, W.-B.| Kumar, V.| Necibi, M.C.| Mu, Y.-J.| Shi, C.-Z.| Chaurasia, D.| Chauhan, S.| Chaturvedi, P.| Sillanpää, M.| Zhang, Z.| Awasthi, M.K.| Sirohi, R.
18	Graphitic carbon nitride based immobilized and non-immobilized floating photocatalysts for environmental remediation	Rana, A.| Sudhaik, A.| Raizada, P.| Nguyen, V.-H.| Xia, C.| Parwaz Khan, A.A.| Thakur, S.| Nguyen-Tri, P.| Nguyen, C.C.| Kim, S.Y.| Le, Q.V.| Singh, P.
19	A comprehensive review of various approaches for treatment of tertiary wastewater with emerging contaminants: what do we know?	Zahmatkesh, S.| Bokhari, A.| Karimian, M.| Zahra, M.M.A.| Sillanpää, M.| Panchal, H.| Alrubaie, A.J.| Rezakhani, Y.

20	Enhanced photocatalytic activity of St-ZnO nanorods for methylene blue dye degradation	Bharathi, D.| Thiruvengadam Nandagopal, J.G.| Rajamani, R.| Pandit, S.| Kumar, D.| Pant, B.| Pandey, S.| Kumar Gupta, P.
21	Mobilization of contaminants: Potential for soil remediation and unintended consequences	Kumar, M.| Bolan, N.| Jasemizad, T.| Padhye, L.P.| Sridharan, S.| Singh, L.| Bolan, S.| O'Connor, J.| Zhao, H.| Shaheen, S.M.| Song, H.| Siddique, K.H.M.| Wang, H.| Kirkham, M.B.| Rinklebe, J.
22	A perspective on biochar for repairing damages in the soil–plant system caused by climate change-driven extreme weather events	Kumar, A.| Bhattacharya, T.| Mukherjee, S.| Sarkar, B.
23	Nanoporous NiO@SiO2 photo-catalyst prepared by ion-exchange method for fast elimination of reactive dyes from wastewater	Lahiri, S.K.| Zhang, C.| Sillanpää, M.| Liu, L.
24	Modelling daily reference evapotranspiration based on stacking hybridization of ANN with meta-heuristic algorithms under diverse agro-climatic conditions	Elbeltagi, A.| Kushwaha, N.L.| Rajput, J.| Vishwakarma, D.K.| Kulimushi, L.C.| Kumar, M.| Zhang, J.| Pande, C.B.| Choudhari, P.| Meshram, S.G.| Pandey, K.| Sihag, P.| Kumar, N.| Abd-Elaty, I.
25	Contamination, exposure, and health risk assessment of Hg in Pakistan: A review	Rashid, S.| Shah, I.A.| Supe Tulcan, R.X.| Rashid, W.| Sillanpaa, M.
26	Reducing chemical oxygen demand from low strength wastewater: A novel application of fuzzy logic based simulation in MATLAB	Zahmatkesh, S.| Klemeš, J.J.| Bokhari, A.| Rezakhani, Y.| Wang, C.| Sillanpaa, M.| Amesho, K.T.T.| Ahmed, W.S.
27	Emergence of MXene and MXene–Polymer Hybrid Membranes as Future-Environmental Remediation Strategies	Khosla, A.| Sonu| Awan, H.T.A.| Singh, K.| Gaurav| Walvekar, R.| Zhao, Z.| Kaushik, A.| Khalid, M.| Chaudhary, V.
28	MXenes based nano-heterojunctions and composites for advanced photocatalytic environmental detoxification and energy conversion: A review	Sharma, S.K.| Kumar, A.| Sharma, G.| Vo, D.-V.N.| García-Peñas, A.| Moradi, O.| Sillanpää, M.

29	Influence of pyrolysis conditions of modified corn cob bio-waste sorbents on adsorption mechanism of atrazine in contaminated water	Binh, Q.A.| Nguyen, V.-H.| Kajitvichyanukul, P.
30	Current status on designing of dual Z-scheme photocatalysts for energy and environmental applications	Kumar, R.| Sudhaik, A.| Khan, A.A.P.| Raizada, P.| Asiri, A.M.| Mohapatra, S.| Thakur, S.| Thakur, V.K.| Singh, P.
31	Removal of lead (Pb+2) from contaminated water using a novel MoO3-biochar composite: Performance and mechanism	Li, Y.| Shaheen, S.M.| Azeem, M.| Zhang, L.| Feng, C.| Peng, J.| Qi, W.| Liu, J.| Luo, Y.| Peng, Y.| Ali, E.F.| Smith, K.| Rinklebe, J.| Zhang, Z.| Li, R.
32	An overview on microalgal-bacterial granular consortia for resource recovery and wastewater treatment	Kant Bhatia, S.| Ahuja, V.| Chandel, N.| Mehariya, S.| Kumar, P.| Vinayak, V.| Saratale, G.D.| Raj, T.| Kim, S.-H.| Yang, Y.-H.
33	A comprehensive review on the removal of noxious pollutants using carrageenan based advanced adsorbents	Sharma, G.| Khosla, A.| Kumar, A.| Kaushal, N.| Sharma, S.| Naushad, M.| Vo, D.-V.N.| Iqbal, J.| Stadler, F.J.
34	An approach to removing COD and BOD based on polycarbonate mixed matrix membranes that contain hydrous manganese oxide and silver nanoparticles: A novel application of artificial neural network based simulation in MATLAB	Zahmatkesh, S.| Rezakhani, Y.| Arabi, A.| Hasan, M.| Ahmad, Z.| Wang, C.| Sillanpää, M.| Al-Bahrani, M.| Ghodrati, I.
35	Accumulation pattern and risk assessment of potentially toxic elements in selected wastewater-irrigated soils and plants in Vehari, Pakistan	Natasha, N.| Shahid, M.| Murtaza, B.| Bibi, I.| Khalid, S.| Al-Kahtani, A.A.| Naz, R.| Ali, E.F.| Niazi, N.K.| Rinklebe, J.| Shaheen, S.M.
36	Waste-to-Resource: New application of modified mine silicate waste to remove Pb2+ ion and methylene blue dye, adsorption properties, mechanism of action and recycling	Ghaedi, S.| Seifpanahi-Shabani, K.| Sillanpää, M.
37	Photocatalytic dye degradation efficiency and reusability of Cu-substituted Zn-Mg spinel nanoferrites for wastewater remediation	Jasrotia, R.| Suman| Verma, A.| Verma, R.| Ahmed, J.| Godara, S.K.| Kumar, G.| Mehtab, A.| Ahmad, T.| Kalia, S.

38	Advanced electro-Fenton degradation of a mixture of pharmaceutical and steel industrial wastewater by pallet-activated-carbon using three-dimensional electrode reactor	Phan Quang, H.H.| Nguyen, T.P.| Duc Nguyen, D.D.| Ngoc Bao, L.T.| Nguyen, D.C.| Nguyen, V.-H.
39	Precipitation of (Mg/Fe-CTAB) - Layered double hydroxide nanoparticles onto sewage sludge for producing novel sorbent to remove Congo red and methylene blue dyes from aqueous environment	Faisal, A.A.H.| Ramadhan, Z.K.| Al-Ansari, N.| Sharma, G.| Naushad, M.| Bathula, C.
40	Photocatalytic degradation of malachite green pollutant using novel dysprosium modified Zn–Mg photocatalysts for wastewater remediation	Jasrotia, R.| Suman| Verma, A.| Verma, R.| Godara, S.K.| Ahmed, J.| Mehtab, A.| Ahmad, T.| Puri, P.| Kalia, S.
41	Advances in biological moval efficiency can be calculated by using tethods for the sequestration of heavy metals from water bodies: A review	Jyoti, D.| Sinha, R.| Faggio, C.
42	Visible-light driven dual heterojunction formed between g-C3N4/BiOCl@MXene-Ti3C2 for the effective degradation of tetracycline	Sharma, G.| Kumar, A.| Sharma, S.| Naushad, M.| Vo, D.-V.N.| Ubaidullah, M.| Shaheen, S.M.| Stadler, F.J.
43	Rubus ellipticus Sm. Fruit Extract Mediated Zinc Oxide Nanoparticles: A Green Approach for Dye Degradation and Biomedical Applications	Dhatwalia, J.| Kumari, A.| Chauhan, A.| Mansi, K.| Thakur, S.| Saini, R.V.| Guleria, I.| Lal, S.| Kumar, A.| Batoo, K.M.| Choi, B.H.| Manicum, A.-L.E.| Kumar, R.
44	Dynamics of microbial community and their effects on membrane fouling in an anoxic-oxic gravity-driven membrane bioreactor under varying solid retention time: A pilot-scale study	Deb, A.| Gurung, K.| Rumky, J.| Sillanpää, M.| Mänttäri, M.| Kallioinen, M.
45	Distribution and ecological risk assessment of trace elements in the paddy soil-rice ecosystem of Punjab, Pakistan	Natasha| Bibi, I.| Niazi, N.K.| Shahid, M.| Ali, F.| Masood ul Hasan, I.| Rahman, M.M.| Younas, F.| Hussain, M.M.| Mehmood, T.| Shaheen, S.M.| Naidu, R.| Rinklebe, J.
46	Metformin as an emerging concern in wastewater: Occurrence, analysis and treatment methods	Balakrishnan, A.| Sillanpää, M.| Jacob, M.M.| Vo, D.-V.N.

47	Distribution, transformation and remediation of poly- and per-fluoroalkyl substances (PFAS) in wastewater sources	O'Connor, J.| Bolan, N.S.| Kumar, M.| Nitai, A.S.| Ahmed, M.B.| Bolan, S.S.| Vithanage, M.| Rinklebe, J.| Mukhopadhyay, R.| Srivastava, P.| Sarkar, B.| Bhatnagar, A.| Wang, H.| Siddique, K.H.M.| Kirkham, M.B.
48	Highly efficient poly(acrylic acid-co-aniline) grafted itaconic acid hydrogel: Application in water retention and adsorption of rhodamine B dye for a sustainable environment	Thakur, S.| Chaudhary, J.| Thakur, A.| Gunduz, O.| Alsanie, W.F.| Makatsoris, C.| Thakur, V.K.
49	Environmental Pollution Remediation via Photocatalytic Degradation of Sulfamethoxazole from Waste Water Using Sustainable Ag2S/Bi2S3/g-C3N4 Nano-Hybrids	Kumar, A.| Sharma, G.| Naushad, M.| ALOthman, Z.A.| Dhiman, P.
50	The practicality and prospects for disinfection control by photocatalysis during and post-pandemic: A critical review	Kumar, A.| Hasija, V.| Sudhaik, A.| Raizada, P.| Nguyen, V.-H.| Le, Q.V.| Singh, P.| Nguyen, D.C.| Thakur, S.| Hussain, C.M.
51	An overview of SnO2 based Z scheme heterojuctions: Fabrication, mechanism and advanced photocatalytic applications	Chawla, A.| Sudhaik, A.| Raizada, P.| Khan, A.A.P.| Singh, A.| Van Le, Q.| Van Huy Nguyen| Ahamad, T.| Alshehri, S.M.| Asiri, A.M.| Singh, P.
52	Critical role of Hyssop plant in the possible transmission of SARS-CoV-2 in contaminated human Feces and its implications for the prevention of the virus spread in sewage	Zahmatkesh, S.| Klemeš, J.J.| Bokhari, A.| Wang, C.| Sillanpaa, M.| Hasan, M.| Amesho, K.T.T.
53	Fe2+, Fe3+, Co2+ as highly efficient cocatalysts in the homogeneous electro-Fenton process for enhanced treatment of real pharmaceutical wastewater	Quang, H.H.P.| Dinh, N.T.| Thi, T.N.T.| Bao, L.T.N.| Yuvakkumar, R.| Nguyen, V.-H.
54	Metallic and bimetallic phosphides-based nanomaterials for photocatalytic hydrogen production and water detoxification: a review	Kumar, A.| Shandilya, P.| Vo, D.-V.N.| Sharma, G.| Naushad, M.| Dhiman, P.| Stadler, F.J.
55	Recent advances on carbon-based nanomaterials supported single-atom photo-catalysts for waste water remediation	Dhiman, P.| Goyal, D.| Rana, G.| Kumar, A.| Sharma, G.| Linxin| Kumar, G.

56	Bio-Inspired Synthesis of Carbon-Based Nanomaterials and Their Potential Environmental Applications: A State-of-the-Art Review	Dutta, V.| Verma, R.| Gopalkrishnan, C.| Yuan, M.-H.| Batoo, K.M.| Jayavel, R.| Chauhan, A.| Lin, K.-Y.A.| Balasubramani, R.| Ghotekar, S.
57	A Review on Carbon Quantum Dots Modified g-C3N4-Based Photocatalysts and Potential Application in Wastewater Treatment	Patial, S.| Sonu| Sudhaik, A.| Chandel, N.| Ahamad, T.| Raizada, P.| Singh, P.| Chaukura, N.| Selvasembian, R.
58	Using ZrO2 coated sludge from drinking water treatment plant as a novel adsorbent for nitrate removal from contaminated water	Phan Quang, H.H.| Phan, K.T.| Dinh, N.T.| Tran Thi, T.N.| Kajitvichyanukul, P.| Raizada, P.| Singh, P.| Nguyen, V.-H.
59	Developing a g-C3N4/NiFe2O4 S-scheme hetero-assembly for efficient photocatalytic degradation of cephalexin	Sharma, S.K.| Kumar, A.| Sharma, G.| Naushad, M.| Ubaidullah, M.| García-Peñas, A.
60	Studies on Synthesis and Characterization of Fe3O4@SiO2@Ru Hybrid Magnetic Composites for Reusable Photocatalytic Application	Kumar, A.P.| Bilehal, D.| Desalegn, T.| Kumar, S.| Ahmed, F.| Murthy, H.C.A.| Kumar, D.| Gupta, G.| Chellappan, D.K.| Singh, S.K.| Dua, K.| Lee, Y.-I.
61	State-of-the-art of research progress on adsorptive removal of fluoride-contaminated water using biochar-based materials: Practical feasibility through reusability and column transport studies	Kumar, R.| Sharma, P.| Yang, W.| Sillanpää, M.| Shang, J.| Bhattacharya, P.| Vithanage, M.| Maity, J.P.
62	High interfacial charge separation in visible-light active Z- scheme g-C3N4/MoS2 heterojunction: Mechanism and degradation of sulfasalazine	Sharma, G.| Naushad, M.| ALOthman, Z.A.| Iqbal, J.| Bathula, C.
63	Pinewood sawdust biochar as an effective biosorbent for PAHs removal from wastewater	Rashad, E.| Saleh, H.N.| Eltaweil, A.S.| Saleh, M.E.| Sillanpaa, M.| Mostafa, A.R.
64	GO/TiO2-Related Nanocomposites as Photocatalysts for Pollutant Removal in Wastewater Treatment	Kong, E.D.H.| Chau, J.H.F.| Lai, C.W.| Khe, C.S.| Sharma, G.| Kumar, A.| Siengchin, S.| Sanjay, M.R.
65	The effect of activated sludge treatment and catalytic ozonation on high concentration of ammonia nitrogen removal from landfill leachate	Yuan, Y.| Liu, J.| Gao, B.| Sillanpää, M.| Al-Farraj, S.

66	Green tea EGCG effectively alleviates experimental colitis in middle-aged male mice by attenuating multiple aspects of oxi-inflammatory stress and cell cycle deregulation	Diwan, B.| Sharma, R.
67	Applications of Microbial Fuel Cell Technology and Strategies to Boost Bioreactor Performance	Maqsood, Q.| Ameen, E.| Mahnoor, M.| Sumrin, A.| Akhtar, M.W.| Bhattacharya, R.| Bose, D.
68	Advances in the role of natural gums-based hydrogels in water purification, desalination and atmospheric-water harvesting	Mittal, H.| Al Alili, A.| Alhassan, S.M.| Naushad, M.
69	Biosorption potential of olive leaves as a novel low-cost adsorbent for the removal of hexavalent chromium from wastewater	Rzig, B.| Guesmi, F.| Sillanpää, M.| Hamrouni, B.
70	Placed-based interpretation of the sustainable development goals for the land-river interface	Vercruysse, K.| Grabowski, R.C.| Holman, I.| Azhoni, A.| Bala, B.| Meersmans, J.| Peng, J.| Shankar, V.| Mukate, S.| Poddar, A.| Wang, X.| Zhang, Z.
71	Elimination of Hazard Cadmium Ions from Simulated Groundwater Using Hydroxyapatite Coated Filter Cake Made of Sewage Sludge and Cement Kiln Dust	Faisal, A.A.H.| Ahmed, D.N.| Saleh, B.| Afzal, A.| Sharma, G.
72	Aminoalkyl-organo-silane treated sand for the adsorptive removal of arsenic from the groundwater: Immobilizing the mobilized geogenic contaminants	Kumar, M.| Mukherjee, S.| Thakur, A.K.| Raval, N.| An, A.K.| Gikas, P.
73	Statistical physics modeling and evaluation of adsorption properties of chitosan-zinc oxide nanocomposites for the removal of an anionic dye	Raval, N.P.| Priyadarshi, G.V.| Mukherjee, S.| Zala, H.| Fatma, D.| Bonilla-Petriciolet, A.| Abdelmottaleb, B.L.| Duclaux, L.| Trivedi, M.H.
74	Anaerobic ammonium oxidation (anammox) technology for nitrogen removal from wastewater: Recent advances and challenges	Chandel, H.| Shyam, K.| Kumar, N.| Sharma, G.| Yadav, M.| Murugesan, S.| Thakur, S.| Saxena, G.
75	Can ‘biodegradability’ of adsorbents constitute an ‘Achilles’ heel’ in real-world water purification? Perspectives and opportunities	Mudhoo, A.| Sharma, G.| Mohan, D.| Pittman Jr., C.U.| Sillanpää, M.
76	Community structure and species diversity of forest vegetation in a protected area of Western Himalayan region of India	Rana, D.| Kapoor, K.S.| Bhatt, A.| Samant, S.S.

77	Surveillance of omicron variants through wastewater epidemiology: Latest developments in environmental monitoring of pandemic	Soni, V.| Paital, S.| Raizada, P.| Ahamad, T.| Khan, A.A.P.| Thakur, S.| Singh, P.| Hussain, C.M.| Sharma, S.| Nadda, A.K.
78	1-Adamantanamine-based triazole-appended organosilanes as chromogenic “naked-eye” and fluorogenic “turn-on” sensors for the highly selective detection of Sn2+ ions	Singh, G.| Kaur, J.D.| Pawan, N.| Diksha, N.| Sushma, N.| Suman, N.| Shilpy, N.| Satija, P.| Singh, K.N.
79	Nanoalumina-supported Mn2O3 as efficient adsorbent for removal of fluoride and arsenic from water: a study from lab to field	Choudhary, D.| Tavar, D.| Singh, P.| Raizada, P.| Ashiq, M.| Srivastava, A.K.| Singh, A.
80	Incorporation of calcium cyanamide and straw reduces phosphorus leaching in a flooded agricultural soil	Zhang, S.| Chen, S.| Jin, J.| Wu, G.| Bolan, N.S.| White, J.R.| Shaheen, S.M.| Rinklebe, J.| Chen, Q.
81	Utilization of sludge-based alginate beads for the application of rare earth elements (REEs) recovery from wastewater: A waste to resource approach	Rumky, J.| Deb, A.| Ramasamy, D.L.| Sillanpää, M.| Häkkinen, A.| Repo, E.
82	Recent trends in Bi-based nanomaterials: challenges, fabrication, enhancement techniques, and environmental applications	Dutta, V.| Chauhan, A.| Verma, R.| Gopalkrishnan, C.| Nguyen, V.-H.
83	Experimental investigation on Defluoridation Competency of mesoporous Prosopis juliflora wood based biomaterials	Ragul, V.| Chitra, B.| Valliammai, C.T.| Suresh, P.| Doss, A.| Prabhu, K.| Thakur, N.| Ahamed, I.N.
84	A brief review to improve the efficiency of solar still using efficient phase change materials	Thakur, V.| Kumar, N.| Kumar, S.| Kumar, N.
85	Enhanced bioenergy and nutrients recovery from wastewater using hybrid anodes in microbial nutrient recovery system	Shahid, K.| Ramasamy, D.L.| Kaur, P.| Sillanpää, M.| Pihlajamäki, A.
86	Low-cost removal of basic red 9 using cow dung ash	Arya, R.K.| Meena, G.| Thapliyal, D.| Barman, S.| Halder, G.| Shandilya, P.
87	Determination of the Physicochemical Quality of Groundwater and its Potential Health Risk for Drinking in Oromia, Ethiopia	Gintamo, B.| Khan, M.A.| Gulilat, H.| Shukla, R.K.| Mekonnen, Z.
88	Economic aspects of bioreactors: current trends and future perspective	Sharma, M.D.| Sharma, S.| Mishra, P.| Kulshrestha, S.
89	Effect of temperature variations in anaerobic fluidized membrane bioreactor: membrane fouling and microbial community dynamics assessment	Theuri, S.| Gurung, K.| Puhakka, V.| Anjan, D.| Sillanpaa, M.

90	A mathematical model for simulation the removal of cadmium and chromium from groundwater using scrap iron and aluminum as permeable reactive barrier	Faisal, A.A.H.| Rashid, H.M.| Sharma, G.| Al-Ansari, N.| Saleh, B.
91	ZrO2-Based Photocatalysts for Wastewater Treatment: From Novel Modification Strategies to Mechanistic Insights	Rani, V.| Sharma, A.| Kumar, A.| Singh, P.| Thakur, S.| Singh, A.| Le, Q.V.| Nguyen, V.H.| Raizada, P.

4. Patents

In response to the growing demand for cutting-edge advancements in water and wastewater treatment, Shoolini University has made significant strides in innovation. To date, the university has secured 33 patents in the field of water purification. Notably, among these patents, one has been granted a utility patent for their groundbreaking photocatalytic water purification technology.

Table 2: List of patents

Sr. No.	Title of the patent	Inventors
1	WATER BOTTLE WITH MECHANICAL HEATING	Dr. Rajesh Kumar, Ritesh Verma, Ankush Chauhan, Rahul Kalia
2	Recyclable Water Closet	Chef Nagendra Yadav, Ankit Shukla, Pratip Mazumdar, Dr Pranshu Chomplay
3	DISTILLED WATER UNIT	Dr. Amit Kumar
4	PORTABLE WATER PURIFIER	Dr. Ankush Chauhan, Dr. Ritesh Verma, Prof.,Rajesh Kumar, Rahul Kalia, Garima Rana
5	POWER WATER PUMP SYSTEM	Dr. Amit Kumar
6	A BIOLOGICAL REACTOR FOR WASTEWATER TREATMENT	Parneet Kaur, Saurabh Kulshreshtha, Pradeep Kumar
7	WATER STORAGE TANK	Dr. Kamal Dev, Dr. Anuradha Sourirajan
8	WATER POT SYSTEM	Dr. Amit Kumar

9	RECYCLABLE WATER CLOSET SYSTEM	Chef. Nagendra Yadav,Mr. Ankit Shukla Mr. Pratip Mazumdar,Dr. Pranshu Chomplay
10	ELECTRICITY GENERATING WATER PUMPING PADDLING SYSTEM	Robin Thakur, Vishal Diwan, Sourav Thakur, Himanshu Sharma, Sahil Chaudhary, Aman Dev Sharma.

Shoolini University's Ph.D. student Amanpreet Kaur Virk is the only Indian to win the Brussels, Belgium-based Young Water Fellowship. She has achieved this for her work on Moringa-based water purification systems where she has worked on a tea bag style equipment that can be used to purify water.

5. Collaborations:

Shoolini University proudly engages in robust research partnerships with esteemed government organizations and non-governmental organizations (NGOs) to address the critical issue of water pollution. This fruitful collaboration has not only resulted in significant advancements but has also garnered funding from various governmental agencies to support our scientists in their endeavours. We boast numerous successful alliances with diverse government research bodies, demonstrating our commitment to environmental stewardship and sustainable development. These collaborations have yielded substantial financial support, exemplified by our receipt of a generous grant of 3 crore INR from Vardhman Textiles Limited, India. This funding is dedicated to the development of a sustainable solution for the purification of polluted industrial water. Our innovative system exhibits great promise for practical applications in wastewater treatment.
To formalize our partnership with Vardhman Textiles Ltd., and to further our goals of sustainable development and environmental protection, Shoolini University has been fortunate to secure funding from a variety of government and non-governmental agencies. The list of these esteemed funding organizations includes:

- Vardhman Textile Limited, Ludhiana, Punjab, India.
- Department of Science and Technology, Ministry of Human Resource Development, New Delhi.
- Himachal Pradesh Council for Science, Technology & Environment.
- Indian Council of Agricultural Research, Government of India.
- Indian Council of Medical Research, Department of Health Research, Ministry of Health and Family Welfare, Government of India.
- Central Council for Research in Ayurvedic Sciences, Ministry of Ayush, Government of India.
- Defence Research and Development Organization, Government of India.
- Memorandum of Understanding (MOU) with iHUB Divyasampark from IIT Roorkee for the development of smart technologies.
- These collaborative efforts underscore our dedication to cutting-edge research and our commitment to addressing pressing environmental challenges.

SCAN ME

Scan to read the MOU between Vardhaman textiles and FLSBM

Our commitment to water conservation extends beyond the confines of our campus. We are actively engaged with the local community, working towards raising awareness and promoting responsible water usage. To this end, we have established rainwater harvesting facilities in the vicinity of our campus. Collected rainwater serves multiple purposes, including landscaping and bore well pit recharging. In addition, we conduct educational awareness programs and workshops for local communities, emphasizing best practices in water management.

Shoolini University Links Industry-Academia Partnership with Vardhaman

In a bid to encourage industry-academia partnership, Shoolini University has signed an MoU with the leading textile company of India, Vardhman Textiles Limited (VTL) with Vardhman contributing Rs 3 crore for research in nanotechnology. By putting nanomaterials and techniques to use in the state-of-the-art lab, Shoolini University aims to work for environmental detoxification, clean energy production, and waste utilization. The MoU was signed by Shoolini University chancellor Prof PK Khosla and Vardhman Textiles director and chairman of CSR, Prafull Anubhai Patel, in the presence of Mr. S P Oswal, Chairman and Managing Director of Vardhman Group.

Figure 7: State-of-the-art Nanotechnology lab

6. Fostering Awareness:

Our bond with the local community is fortified by our active involvement in promoting awareness about water conservation. As water scarcity is a pressing concern in our hilly locale, we consider responsible water usage and reuse as essential imperatives for the local community. We actively engage with local communities through training and demonstration camps, emphasizing the significance of water conservation steps and organizing awareness events.

Furthermore, our students play an active role in environmental preservation by regularly visiting the nearby water stream (Ashwani Khadd) and local water bodies in nearby villages for clean-up initiatives. We also educate local communities about the plantation of drought-tolerant plants, aiming to conserve water resources and bolster groundwater levels.

Figure 8: Cleanup drive of the local stream

7. Conclusion

In conclusion, Shoolini University remains steadfast in its commitment to water conservation, sustainable water management, and pioneering research. Our dedication extends not only to our campus but also to our local community and government partners. As we continue to evolve and innovate, we remain resolute in our pursuit of addressing the challenges posed by clean water and sanitation, contributing meaningfully to the realization of Sustainable development goals.