

India – Netherland “LOTUS^{HR} Project”

Department of biotechnology (DBT) and NWO, the Netherlands Science Agency announced a joint call for proposals to clean the Barapullah drain in New Delhi.

In May, 2017 The Minister of Science & Technology, Dr. Harsh Vardhan, Minister of Foreign Affairs, The Netherlands, Mr. Bert Koenders and Lt. Governor of Delhi, Sh. Anil Baijal laid the foundation stone to mark the beginning of work on cleaning the Barapullah drain.

About LOTUS-HR:

- LOTUS-HR stands for **Local Treatment of Urban Sewage streams for Healthy Reuse plant**.
- The project was initiated in 2017. It aims to demonstrate a novel holistic waste-water management approach that will produce clean water that can be reused for various proposes.
- The project also aims to simultaneously recover nutrients and energy from the urban wastewater thus converting drain into profitable mines.
- The project is jointly supported by Department of Biotechnology, Government of India and the Netherlands Organization for Scientific Research, Government of the Netherlands.
- The location of the project is Barapullah drain, New Delhi. The partners in the project are IIT-Delhi, NEERI and The Energy and Resources Institute (TERI).

Objective: To demonstrate a holistic wastewater management approach that will produce clean water which can further be reused for various purposes.

Bodies Involved: It is jointly supported by Department of Biotechnology, under Union Ministry of Science and Technology and Netherlands Organization for Scientific Research. Moreover, IIT-Delhi, NEERI and The Energy and Resources Institute (TERI) are partners in this project.

Technology being used in LOTUS-HR is called *wetland technique*.

Background of “LOTUS – HR”

During phase first researchers at IIT Delhi had collaborated with other Indian partners (TERI, NEERI) as well as researchers from Netherlands to take up the ‘cleaning’ of Barapullah drain in Delhi.

The five year project with a budget of Rs. 18 crore will study the degradation and removal of conventional pollutants as well as emerging contaminants in the drain, which are a major source of pollution in Yamuna River. Separate labs will be set up at IIT Delhi and at the banks of the drain near the Sun-Dial Park to analyze the pollutants. In the first two years different reactor systems will be studied to get a super-efficient reactor with a broader objective to treat 1 million liters of water per day.

The project titled Local Treatment of Urban Sewage Streams for Healthy Reuse (LOTUS-HR) aims to demonstrate a novel holistic (waste-) water management approach that will produce clean water that can be reused for various proposes (e.g. industry, agriculture, construction etc.), while simultaneously

recovering nutrients and energy from the urban waste water, thus converting drain into profitable mines. Special attention will be paid to pathogen removal and removing conventional and emerging pollutants.

Prof. T R Sreekrishnan of the Department of Biochemical Engineering and Biotechnology maintains that besides making the water potable it will also be made fit for use in agriculture and industry. “The method entails modification of treatment technology. The anaerobic digester will treat the water and the semi treated water will go for further treatment.”

The program will be built around the realization of a pilot-scale demonstration site, a living lab, in which the different proposed technologies, suitable for the Indian urban situation for waste water treatment and subsequent reclamation, will be implemented, integrated and demonstrated. The program will focus on feasibility of proposed technologies in meeting the required removal efficiencies as well as the health impact of use of reclaimed water, evaluated via QMRA and QCRA methodology. This test facility, located next to the Barapullah Drain, will lead to education and research possibilities in the Delhi region and capacity building in the area of waste water treatment for reuse.

Quote by Prof. T R Sreekrishnan to CSE: LOTUS-HR is an Indo-Dutch project (jointly funded by DBT and NWO) to develop a tool-box of viable technologies to treat the urban sewage streams which ultimately adds to the pollution load of rivers. The project is focusing on the water flowing in the Barapullah drain, but the objective is not to treat the complete drain. You will understand and appreciate that treating the complete drain is not a job to be taken up by academicians like us. You may like to know that the average flow in this drain is 125 million litres per day (MLD). It is an ongoing project and expected to continue till March, 2022.

LOTUS - HR PROJECTS

The 3 research lines are further divided into five distinct projects which form the backbone of the research within LOTUS – HR. The goals of the projects are aligned in such a way that through joint effort the ambitions of the LOTUS – HR programme can be fulfilled.

- **Project 1A** - SOCIALLY ACCEPTABLE IMPLEMENTATION STRATEGIES (Through understanding people’s perceptions towards water reuse)
- **Project 1B** - REDUCING HEALTH RISKS (Through Quality)
- **Project 2** - SEWAGE PRE-TREATMENT and Energy Recovery
- **Project 3A** - VITAL URBAN FILTERS (A Novel Solution for Safe and Productive Use of Wastewater)
- **Project 3B** - MICROALGAE TECHNOLOGY (For nutrient removal)

Among those five projects, Project 3A is based on decentralized wastewater treatment and reuse approach.



Project 3A

VITAL URBAN FILTERS

A Novel Solution for Safe and Productive Use of Wastewater
(Vertical Flow Constructed Wetland)

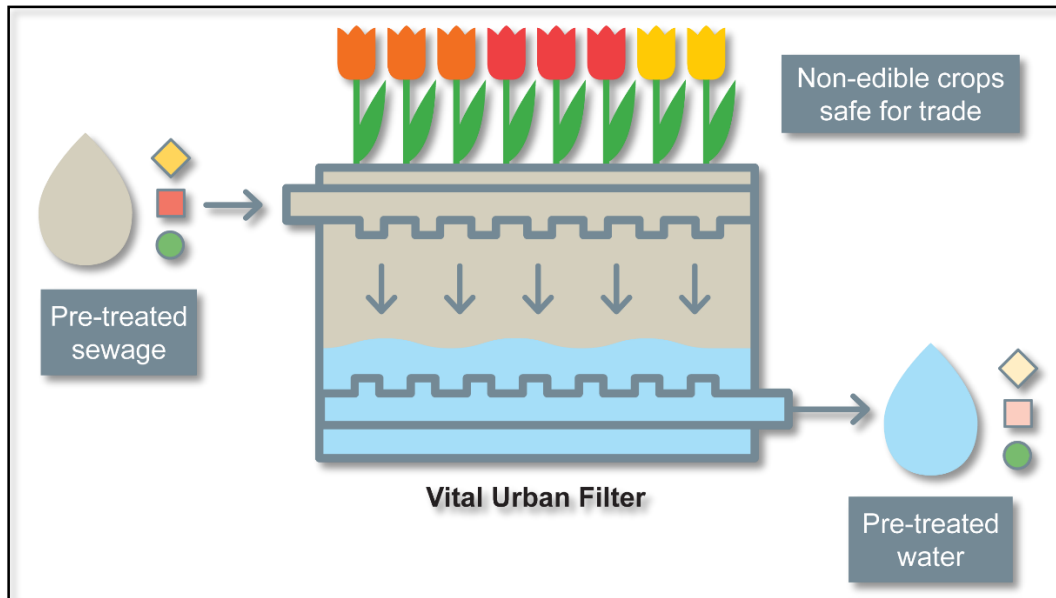
Objective

To be able to produce safe reusable water, pollutants have to be removed from the pre-treated drain water. Our aim is to develop the compact, robust and nature-based Vital Urban Filters (VUFs). This water treatment system is able to produce safe reusable, nutrient rich water for agricultural purposes while having an added social and economic value through the growing of plants.

Scientific Background: Technology

The Vital Urban Filters are based on the principle of conventional vertical flow **constructed wetland** that are commonly used in **decentralized wastewater management**. The filter consists of a flat bed of hydroponic filter material planted with ornamental plants. The filter materials are highly porous providing a high surface area for biomass. As the influent percolates through the filter, heavy metals, pathogens and micro pollutants are removed through the interaction of the plants, filter materials and bacteria.

The Vital Urban Filters are based on the principle of conventional vertical flow constructed wetland that are commonly used in decentralized wastewater management. The main difference is its smaller footprint due to the selection of highly efficient (high porosity and surface area) filter materials. These filter materials can adopt more biomass and thus can enhance sorption and degradation processes of pollutants.



The filter consists of a flat bed of hydroponic filter materials (e.g. mineral wool, pumice, wood fibre and coco fibre, commonly used in horticulture as a growth medium) planted with ornamental plants. As the filter material is highly porous, a high surface area is available for adsorption and bacteria (biomass) to grow on. These bacteria are responsible for the biological removal of pollutants. By using plants, the treatment process is improved because the plants' roots take up nutrients from the water and provide oxygen into the filter that bacteria can use.

(Pre- treated) influent, for example from anaerobic membrane bioreactors (project 2) is rich in macro nutrients, such as nitrogen and phosphorus, making it excellent for irrigation. As the influent percolates down through the filter bed, it undergoes various physical, chemical and biological transformations processes. The interplay of the microbes, plants and filter material results in the removal of pollutants. The treated effluent, free of harmful constituents and rich in nutrients can now be safely reused for irrigation or other purposes.

The Vital Urban Filters are constructed using efficient filter materials, which provides major advantages for the eco-friendly VUF, including a simple and compact design and low investment and operational costs. This is all achieved while maintaining a good effluent quality and providing added economical and aesthetic values.

Recently India and Netherlands has launched the second phase of the LOTUS-HR as a part of joint collaboration. Click below for more info:-

<https://www.chronicleindia.in/current-news/258-second-phase-of-lotus-hr-project-launched>

Field visit was done by a team of CSE to gather information on the project:

Date of Site Visit – 7th November, 2019

Attendees:-

1. Prof. T R Sreekrishnan – IIT, Delhi
2. Dr. Mahreen Matto – CSE, Delhi
3. Mr. Jyoti Parsad – CSE, Delhi
4. Mr. Vishnu – IIT, Delhi
5. Mr. Rishabh – IIT, Delhi

Meeting with Professor T R Sreekrishnan was held at the Biochemical Engineering Department of IIT Delhi to collect information regarding an Indo-Dutch collaborative project for Barapullah drain i.e. LOTUS-HR. We had a fruitful discussion with Prof. Sreekrishnan and asked for the permission to visit interventions opted by IIT Delhi to clean Barapullah drain. In continuation a detailed site visit made to the Barapullah site along with researchers from IIT Delhi to experience inventions opted by IIT Delhi, TERI and NEERI.

Key Points discussed during meeting:

1. As per Professor T R Sreekrishnan the project was initiated in April 2017. And the first phase of project LOTUS-HR is all about to setup different wastewater treatment options to develop a toolbox of various technologies.
2. In LOTUS-HR project, the Indian organizations like NEERI, TERI and IIT Delhi are engaged to work in collaboration with various Dutch agencies which includes five institutes from Netherlands.
3. In first phase of the project, a lab was established near Sun Dial Park. The Professor said that first phase of project is still continuing and simultaneously, the second phase of the project was launched during the recent visit by Dutch King and Queen.
4. As per Professor, different agencies from India are working on different aspects like TERI is working on social aspects, NEERI is handling analytic techniques and risk assessment part and IIT Delhi is more into research and development activities.

Key Observations at Site:

1. Indo – Dutch collaboration established an on-site laboratory near Barapullah drain.
2. They have setup pilot wastewater treatment plants based on different technologies like – Photo bioreactor, Modified Trickling Filter, ASP, Constructed wetland, Floating wetland, Anaerobic Bioreactor, Membrane Bioreactor (MBR). Periodically, they are testing effluent from all the treatment plants.
3. Till date they're just trying different technologies to prepare a toolbox of various technologies. In 2nd phase they are thinking to take it to higher level of wastewater testing (from 100 L/D to 10000 L/D).
4. An organization DESMI enviro clean is handling the Operation & Maintenance

activities.

- An automatic solid waste extractor has been introduced to deal with solid waste generated.



Figure 1. Details of Barapullah drain



Figure 2. Informatory display board

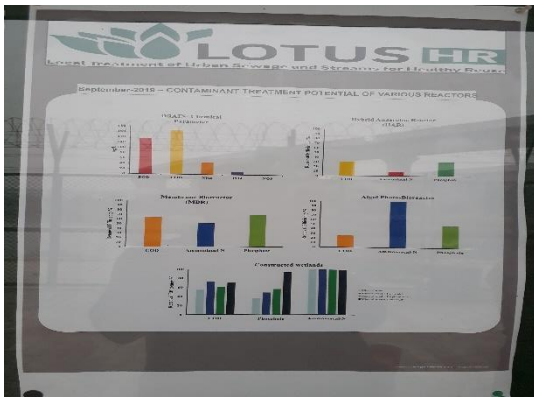


Figure 3. Effluent comparison chart for different technologies



Figure 4. Floating Wetlands

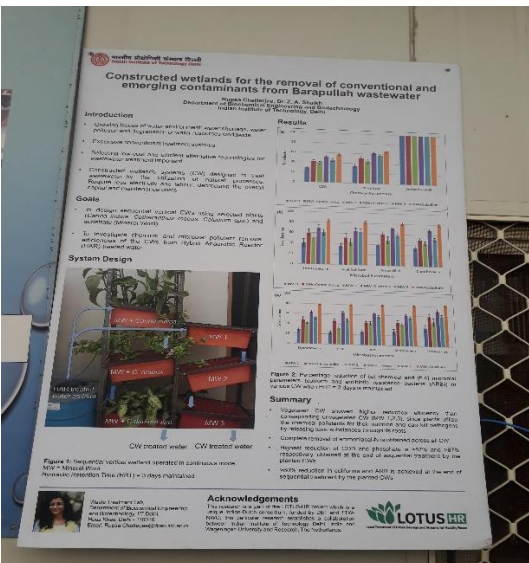


Figure 5. Display board regarding CW



Figure 6. Constructed Wetlands (CW)



Figure 7. Hanging constructed wetlands



Figure 8. Photo-Bioreactor



Figure 9. Information regarding Photo Bioreactor



Figure 10. Modified Tricking Filter



Figure 11. Activated Sludge Process (ASP)



Figure 12. Laboratory Scale ASP



Figure 13. Lab Scale Photo-Bioreactor with LEDs



Figure 14. Anaerobic Bioreactor



Figure 15. Treatment unit owned by TERI



Figure 16. Inside view of Lab

For more information, please visit the website: <https://lotushr.org/>