

25<sup>th</sup> – 27<sup>th</sup>  
October,  
2018

# Academia Engagement on Decentralized Sanitation

## Workshop on Community based technologies for Domestic Wastewater Treatment and Reuse



Department of Urban Planning,  
Lovely Professional University, Bhopal



## **Introduction**

Lovely Professional University organized a 3day workshop from 25<sup>th</sup> to 27<sup>th</sup> October, 2018 on the theme: Community based technologies for Domestic Wastewater Treatment and Reuse as a part of the memorandum of understanding with National Institute of Urban Affairs.

The workshop started with focus on Wastewater and Wastewater management covering issues related to Point and Non-point Sources, Untreated Wastewater Disposal and various types of Treatment Systems that includes Household-level/on-site treatment systems, Neighborhoods level/off-site treatment systems etc.

Field exposure to students was given on the Day 2 with the visit to STP at Lovely professional University Campus. The Day 3 carries forward the importance and techniques of wastewater management with the help of best practices and case study.

**Table: Schedule followed for Workshop on Community based technologies for Domestic Wastewater Treatment and Reuse**

<b>Day 1</b>		
<b>S.no.</b>	<b>Topic</b>	<b>Time</b>
<b>A</b>	<b>Introduction to Wastewater and Wastewater management</b> <ul style="list-style-type: none"> <li>• Dry vs Wet Sanitation system</li> <li>• Point and Non-point Sources</li> <li>• Effects of Untreated Wastewater Disposal</li> </ul>	9:00 to 10:00
<b>B</b>	<b>Current Sanitation Issues in Indian Cities</b> <ul style="list-style-type: none"> <li>• Public health and community-related issues.</li> <li>• Environmental Issues</li> </ul>	10:00 to 11:30
<b>T e a B r e a k</b>		11:30 to 11:45
<b>C</b>	<b>Treatment Systems</b> <ul style="list-style-type: none"> <li>• Household-level/on-site treatment systems</li> <li>• Neighborhoods level/off-site treatment systems</li> </ul>	11.45 to 13.45
<b>Lunch</b>		13:45 to 14:30
	<b>Treatment Systems</b> <ul style="list-style-type: none"> <li>• Land-based treatment technologies</li> <li>• Anaerobic treatments systems</li> </ul>	14:30 to 16:00
<b>T e a B r e a k</b>		16:00 to 16:15
	<b>Treatment systems</b> <ul style="list-style-type: none"> <li>• Soil aquifer treatment (SAT)</li> <li>• Neighborhoods level/off-site constructed wetlands</li> <li>• Floating aquatic Macrophytes</li> <li>• Comparative analysis</li> </ul>	16:15 to 17:00
<b>Day 2– Field Visit</b>		
<b>Day 3</b>		
<b>S.no.</b>	<b>Topic</b>	<b>Time</b>
<b>D</b>	<b>Planning and implementing wastewater reuse projects</b> <ul style="list-style-type: none"> <li>• Scope and Demand</li> <li>• Types and Stages</li> <li>• Designated Reuse Criteria</li> </ul>	9:00 to 10.30
<b>E</b>	<b>Modern Technologies and Best Practices</b> <ul style="list-style-type: none"> <li>• Wastewater recycle and Reuse-Technology Evolution and Costs</li> <li>• Developments in natural sludge de-watering technology.</li> <li>• Sludge reuse in Egyptian agriculture</li> </ul>	10:30 to 11:30
<b>T e a B r e a k</b>		11:30 to 11:45
<b>F</b>	<b>Round table discussion and understanding site visit tool kit and planning approach for decentralized and onsite sanitation plan</b>	11:45 to 14:00
<b>Lunch</b>		14:00 to 15:00
<b>G</b>	<b>Valedictory Session</b>	15:00 to 17:00

## Day 1: Session Details

The day started with Introduction to Wastewater and Wastewater management with the focus on Dry and Wet Sanitation system, Point and Non-point Sources and Effects of Untreated Wastewater Disposal followed by discussion on Current Sanitation Issues in Indian Cities. Public health and community-related issues, Environmental Issues were the top agenda.

Participants were further exposed to various types of Treatment Systems that includes Household-level/on-site treatment systems, Neighborhoods level/off-site treatment systems

Land-based treatment technologies, Anaerobic treatments systems, Soil aquifer treatment (SAT), Neighborhoods level/off-site constructed wetlands, Floating aquatic Macrophytes were also introduced accompanied by their Comparative analysis

### Session 1: Introduction to Wastewater and Wastewater management

Dr. Mrunmayee Manjari Sahoo

Assistant professor, School of Civil Engineering, Lovely Professional University

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The first session focused on domestic water treatment and its management. The discussion began with the various parameters determining the water quality i.e. Nitrates, BOD (Biological oxygen demand), COD (Chemical oxygen demand), TDS (Total dissolved solids), etc.

Presence of various activities near the water bodies of a city influences both surface and ground water quality of the area. For example: Presence of an industry near some water body would affect the same due to releasing of harmful effluents through both solid and liquid waste into the environment.

Basic sanitation principles discussed were :

1. Dry Cleaning: the process consists of various steps which includes identification of debris, picking up of the bigger pieces, brushing up the rest remaining pieces and vacuuming up the remaining smaller pieces which cannot be picked up. Mopping, flashlight inspection and letting it dry are the last stages of dry cleaning.
2. Wet Cleaning/Dry Out After Wet Cleaning: Wet cleaning on the other hand includes wet rinse once the scrapping and dry picking up is done. Dry powder after the use of cleaning solutions is used for cleaning.
3. Sequence Cleaning: It is a top down process which begins with the cleaning of sanitary points, then niches cleaning followed by floor level cleaning, least sanitary point cleaning and drying out after cleaning.
4. Drain Cleaning: Installs Lock ring on drain brush handle to mark point for stroke distance. Shield Shroud goes over handle and covers drain opening during brushing step. Bristles into drain pipe throat only about 5- 5 ½ inches, and not into wet line fill of drain; only go distance of bristle height.
5. Team Cleaning:

It was discussed that more than 50% of the Indians practice open defecation out of which 1000 children younger than the age of 5 years die due to diarrhea, hepatitis etc. The crisis is acute for girls who reach puberty.



Picture 1: Session on Introduction to Wastewater and Wastewater management conducted by Dr. Mrunmayee Manjari Sahoo

**Human nutrient cycle:** Utilization of composted human feces and urine as organic fertilizers completes the human nutrient cycle by enriching the farming soil with nutrients.

The next topic of discussion was “classes of pollution”. The various classes of pollution are:

- Point source pollution: This type of pollution comes from a definite source like factories, refineries etc.
- Non-point source pollution: This type of pollution doesn't come from a single point or location, but from automobiles, agriculture run-off, fertilizers etc. instead.

### **Effect of Water pollution Due to Untreated Sewage**

Pollution is the process whereby harmful substances are added to the environment. Substances that cause pollution are termed pollutants. Water pollution is the contamination of water bodies. It can be caused by:

- discharge of untreated sewage into water bodies,
- dumping of inorganic waste material into water bodies.
- excessive use of fertilisers and insecticides

(a) Untreated sewage

- Sewage refers to waste materials from homes and industries.

- Untreated sewage may contain disease-causing bacteria and that can result in epidemics if discarded into water bodies. (e.g Cholera) .
- Untreated sewage also contains phosphates and nitrates that can lead to eutrophication.

(b) Inorganic waste

Inorganic waste includes poisonous metals (e.g. mercury, arsenic and cadmium) and some types of pesticides.

- Poisonous metals that are dumped into rivers or lakes are extremely harmful to humans.
- A tragic example would be the case of mercury poisoning in 1971 in Minamata, Japan.

(c) Chemical fertilisers

- Chemical fertilisers that contain nitrates and phosphates are used to increase crop yield.
- Excessive use of these fertilisers can lead to phenomena called eutrophication.

**Bioaccumulation**

- Insecticide can enter the food chain by the aquatic plant absorbing it.
- When the primary consumer feeds on the plant, the insecticide is transferred from the plant into the body of the consumer.
- Since the DDT (Dichlorodiphenyltrichloroethane) is insoluble and is stored in the fatty tissues of organisms, it will be accumulated in the organism and pass down to the next higher trophic level in the food chain.
- The insecticide concentration increases and remains highest in the bodies of the final consumers.

## Session 2: Current Sanitation Issues in Indian Cities

Dr. R.L. Sharma

Associate professor, School of Civil Engineering, Lovely Professional University

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Sanitation basically is all about waste water management system, excreta management and solid waste management. It deals with the public health conditions, treatment and disposal of human waste along with clean drinking water.

The main process of management includes:

1. Capture: by capturing it means that it deals with the collection.
2. Storage: storage here constitutes of the collection and dealing with the storage of material.
3. Transport: transportation is the basic concept of moving the material from one place to another. Basically, from the collection point to the treatment or disposal site.
4. Treatment and disposal: the treatment is the final step which constitutes of treatment and disposal of the same.

The main aim of sanitation in India is to protect the human health. The public health issues in India constitute of major problems and facts like:

1. Under nutrition: UP, MP, Jharkhand and Tamil Nadu are the states with most malnourished children (60% approx.)
2. Over weight
3. Communicable diseases: major diseases in Indians include HIV/AIDS, Diarrhoea, dengue and chikungunya
4. Progress in health status

One third of waste water generated is collected in class I and class II towns of the country. Around 300 odd cities have sewerage network.

Major concern of the authorities in India regarding people of the country is as follows:

1. **Access to clean drinking water:** Inaccessibility to clean drinking water is one of the major reasons for increasing number of health issues amongst the citizens of the country. Hence, access to the same is amongst the top major issues in order to bring up healthy future for the nation.
2. **Sanitation and environmental issues:** Sanitation and environmental issues are the recent most important issues in the country. Both these issues end up in serious health problems amongst both adults and the children.
3. **Sanitation and gender equality:** Sanitation and gender equality are related to each other in an adverse way. Women and teenage girls are affected the most in this inter-relation of sanitation and gender. Inappropriate facilitation of sanitation facilities for women is one major cause of increasing health issues amongst them.



Picture 2 Session on Sanitation Issues in India conducted by Dr. R.L. Sharma

**Current national health profile:**

The current national health profile of the country shows that according to the central bureau of health intelligence, only 1.02% of our total GDP is been contributed to the health profile when the actual figure is supposed to be 1.3% of the total GDP.

The standards for a doctor population ratio that is to be met is 1:1100, which isn't met anywhere in the country right now. Bihar tops in the ranking of lack of doctors, followed by UP, Jharkhand and Madhya Pradesh.

The remedy measures to cater with the problems discussed above include:

1. Proper governance: Proper governance in order to have proper implementation and strict policies is a necessity to get over with the problems been discussed above.
2. Information management system: Making people aware of the health care and managing the system is another important necessity for overcoming the problems.
3. Health care financing: Facilitating requires funding or financing. This is taken care of by the state and central government along with the urban local bodies.
4. Human resource: Human resource acts as volunteer in spreading awareness and convincing the common people for better management and implementation of plans and projects.

Preventive health care, in short is the only way to cater the issues related to health problems in India. Facing the issues and coming up with better plans and implementation along with the management has become a need of the hour.

### **Session 3: Treatment Systems: Household-level/on-site treatment systems and Neighborhoods level/off-site treatment systems**

Ms. Ambika Thakur

Assistant professor, Environmental and Water Resource Engineering, School of Civil Engineering, Lovely Professional University

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The session started with the discussion on the general understanding about the types of wastewater generated from our household namely Black water and Grey water, continuing with its impact analysis on the environment and how it is affecting human life directly and indirectly.

As the theme of the session was community based technologies for treating domestic waste water- the two major things that is onsite handling of waste water and offsite handling of waste water were discussed in an elaborative manner.

Under onsite handling, Onsite wastewater management systems (commonly known as **septic tanks**) are used on residential, community and business premises. They treat, then recycle or dispose of: **Greywater**, which comes from showers, baths, hand basins, washing machines, laundry troughs and kitchens, **Blackwater**, which is toilet waste (from water-flush, incineration or dry composting systems), **Sewage**, which is combined greywater and Blackwater.

**Septic tank** is an underground chamber made of concrete, fiberglass or plastic, through which domestic wastewater (sewage) flows for basic treatment. Settling and anaerobic processes reduce solids and organics, but the treatment efficiency is only moderate (referred to as "primary treatment"). Septic tank systems are a type of simple onsite sewage facility (OSSF). They can be used in areas that are not connected to a sewerage system, such as rural areas. The treated liquid effluent is commonly disposed in a septic drain field, which provides further treatment. However, groundwater pollution may occur and can be a problem.

The major advantages of using this method are: The maintenance of the septic system is very economical. You need a small space compared to other water treatment systems. Water quality is obtained. People who use it do not have to be highly trained because their system is simple and easy to operate. It is an excellent option for rural communities, buildings, parks and motels.

Related disadvantages were also discussed: Septic tanks are a great option, but if proper maintenance is not given to the septic system, it can also bring many problems for its users. The most common disadvantages of septic systems are: In some cases, septic tanks may lead to contamination in water, which may be used for human use and consumption. Foul odors caused by poor maintenance or clogged septic systems a poorly maintained septic system can be a breeding ground for flies and insects that can transmit infectious diseases that can put in danger you and your family's health.

Under offsite handling techniques, it is done by bringing the wastewater at far distance through sewers from domestic regions and then treatment is given. The whole arrangement is



Picture 3 Session on Treatment Systems by Ms. Ambika Thakur

known as sewerage system. Generally, this type of handling is used in Mega Cities or in urban area. Municipal Corporation of the area provides the sanitation facilities in the city, then wastewater is collected at distant place, and treatment is provided. Treated water is either discharge into rivers or applied on Land for irrigation Purpose.

Sewerage system and its types were discussed, **Sewerage system**, network of pipes, pumps, and force mains for the collection of wastewater, or sewage, from a community. Generally there are three types of sewerage system which are used in urban areas.

- Separate Sewerage System
- Combine Sewerage System
- Partial Sewerage System

After this, technologies used under this method were discussed such as Based on characterisations; treatments are classified as Preliminary Treatment, Primary Treatment, Secondary Treatment and Tertiary Treatment.

Preliminary treatment of wastewater consists of the following steps: Screening, Comminution, Grit Removal, Oil and Grease Removal, Pre-Aeration.

Secondary Unit consists of Biological Unit & Secondary clarifier. Several aerobic biological processes are used for secondary treatment differing primarily in the manner in which oxygen is supplied to the microorganisms and in the rate at which organisms metabolize the organic matter. There are two types of growth of micro-organism are used for secondary treatment : Attached Growth (Biofilm Method) &Suspended Growth (Aeration Method).

Other Miscellaneous Methods were also discussed such as Membrane Technologies (membrane bio-reactor), Moveable bed Reactors or (fluidized bed reactor) & Oxidation Pond (lagoons)

To ensure that the effluent being discharged to rivers, lakes, wetlands and the sea meets consent standards, tertiary treatment of wastewater or effluent polishing provides a final wastewater treatment stage. It may be necessary to remove additional solids and/or carbonaceous biological oxygen demand (BOD) and further nitrification may be required.

Most of the adopted methods for Tertiary Treatment are: Disinfection (chlorination), Ozonation & UV treatment.

## **Session 4: Treatment Systems: Land-based treatment technologies and Anaerobic treatments systems**

Dr. Pushpendra Kumar Sharma

Associate professor, Environmental and Water Resource Engineering, School of Civil Engineering, Lovely Professional University

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In continuation with the earlier session, this session is particularly focussing on different Land Based treatment methods for treating wastewater. The major agenda focussed in this session was low cost sanitation and environmental protection while providing additional benefits from the reuse of water.

For the same following three types of systems were discussed:

1. Mechanical treatment systems
2. Aquatic systems
3. Terrestrial systems

As the session continuous more detailing regarding the three mentioned systems were discussed

In mechanical treatment system combination of physical, biological, and chemical processes are being utilized in order to achieve the treatment objectives. Various types of instrumentation control flow of wastewater in the system. For example, processes such as trickling filter solids contact process (TF-SCP), activated-sludge process etc.

Aquatic Treatment Technologies generally includes Facultative lagoons having the main concept that the water layer near the surface is aerobic while the bottom layer, which includes sludge deposits, is anaerobic. After that Constructed wetlands, aqua cultural operations, and sand filters are generally the most successful methods of polishing the treated wastewater effluent from the lagoons.

Terrestrial treatment systems include slow-rate overland flow, slow-rate subsurface infiltration, and rapid infiltration methods. In addition to wastewater treatment and low maintenance costs, these systems may yield additional benefits by providing water for groundwater recharge, reforestation, agriculture, and/or livestock pasturage.

After discussing the details regarding each of the treatment system, discussion moves towards the operation and maintenance related detailing. For the same following points are discussed with the students in order to make them more conceptually clear about the adoption for any of the particular technology system

Operation and maintenance depends on the particular technology used. In mechanical activated-sludge plants, maintenance requirements consist of periodically activating the sludge pumps, inspecting the system to ensure that are no blockages or leakages in the system, and checking BOD and suspended solids concentrations in the plant effluent to ensure efficient operation.

In the case of aquatic treatment systems using anaerobic reactors and facultative lagoons for primary wastewater treatment, the following operational guidelines are followed:

- Periodically clean the sand removal system (usually every 5 days in dry weather, and every 2 to 3 days in wet weather)
- Daily remove any oily material that accumulates in the anaerobic reactor.
- Daily remove accumulated algae in the facultative lagoons.
- Open the sludge valves to send the sludge to the drying beds.
- Establish an exotic aquatic plant removal program (aquatic plant growth can hamper the treatment capacity of the lagoons).
- Properly dispose of the materials removed, including dried sludge.



Picture 4 Session on Treatment Systems by Dr. Pushpendra Kumar Sharma

After knowing about the working, operation and maintenance regarding each of the treatment system, suitability regarding them was also discussed as in to make students clear about the spatial arrangement for a particular system, such as mechanical systems are more suitable for places where land availability is a concern, such as hotels and residential areas. Mechanical plants are the least land intensive of the wastewater treatment methods based on natural processes. Lagoon and oxidation pond technologies are suitable where there is plenty of land available. Slow-rate systems require as much as 760 acres. Hybrid hydroponic cultivation techniques, using aquatic and terrestrial plants for the treatment for wastewater, also require relatively large amounts of land, and are best suited to regions where suitable aquatic plants can grow naturally.

For concluding the session, advantages and disadvantages related to each of the system were discussed in order to really understand the problems and potential of these systems in order to adopt any of them for specific site. For making students aware from the ground situation facts

and figures are also presented in the session such as In India about 78% of the urban population has access to safe drinking water and about 38% of the urban population has access to sanitation services. Discharge of untreated sewage in water courses both surface and ground waters is the most important water-polluting source in India. Out of about 38000 million litres per day of sewage generated treatment of only about 12000 million liters per day; is a gap between generation and treatment of wastewater in India.

## Session 5: Treatment Systems

### **Soil aquifer treatment (SAT), Neighborhoods level/off-site constructed wetlands and Floating aquatic Macrophytes**

Dr. Mihir Lal

Head, Geotechnical Domain, School of Civil Engineering, Lovely Professional University

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In continuation with the earlier session, this session is particularly focussing on different Waste Water Treatment System namely **Soil Aquifer Treatment, Floating Macrophytes, and Offshore Wetlands.**

Soil Aquifer Treatment (SAT) is one of the method, which is receiving growing attention because it features advantages such as Inherent natural treatment, Inbuilt storage capacity to buffer seasonal variations of supply and demand As well as mixing with natural water bodies, which promotes the acceptance of further uses, particularly indirect potable use which is making this particular system standing out of all existing treatment system. SAT is one method used to recharge groundwater aquifers from the surface or from below the surface. Typically, SAT is used to enter either storm water or pre-treated wastewater through a recharge basin (also: infiltration basin) or an injection well, e.g. when space is not available for a recharge basin.

In following of the introduction to the system, working is also discussed, as the effluent moves through the soil and the aquifer; it can undergo significant quality improvements through physical, chemical and biological processes. The water is stored in the underlying unconfined aquifer generally for subsequent reuse.

The major objectives related to the soil aquifer treatment system is also been discussed namely Safer Water Storage, Mixing Water Flows, Quality Improvement and Mitigate Saltwater or Contaminants Intrusion.

Applicability is one of the major topic, which needs to be discussed in order to be rational while giving any kind of proposal etc. for the same system's applicability part discussed in a deeper manner. Following points are covered in the discussion:

- SAT can be applied when facing issues with the quantity and the quality of groundwater aquifers.
- It can be an option where groundwater levels are declining due to overexploitation (existing urban conditions)
- Where a substantial part of the aquifer has already been desaturated (e.g. when regeneration of water in wells is slow),
- On the other hand, where groundwater from wells is inadequate during the dryer months.
- Also as another benefit, SAT can contribute to an improvement of the aquifer water.
- The suitability of SAT is dependent on the characteristics of the local groundwater and its performance is closely related to local conditions such as the quality of the influent, soil type and purpose of water

The second method that was discussed in the session was Floating Aquatic Macrophytes, The primary removal mechanisms for wastewater constituents in aquatic plant systems are essentially the same as for mechanical systems: sedimentation, filtration, nitrification/denitrification, adsorption, and precipitation. Plant systems also add nutrient and dissolved constituent uptake and subsequent removal by plant harvest. Plants and their associated microbial populations may be used to perform the physical removal, as in the case of a shallow water hyacinth basin where the roots filter out solids and adsorb dissolved constituents.



Picture 5 Session on Treatment Systems by Dr. Mihir Lal

The plants may be alternately used simply to create the proper environment for treatment to occur, such as a deep basin with a duckweed or water fern cover that provides quiescent, dark water ideal for algae removal. Water hyacinths, water lettuce, pennywort, and other large-rooted floating plants may be used in systems managed for nitrification/denitrification by allowing the water to become anaerobic. In this case, nitrification occurs in the layer of aerobic bacteria attached to the roots. Any nitrates, which are not consumed by the plant quickly, diffuse into the bulk of the water where they are subject to denitrification

Last method of treatment discussed with Offshore Wetlands, A constructed wetland is an engineered sequence of water bodies designed to filter and treat waterborne pollutants found in sewage, industrial effluent or storm water runoff. Constructed wetlands are used for wastewater treatment or for greywater treatment. They can be used after a septic

tank for primary treatment (or other types of systems) in order to separate the solids from the liquid effluent.

Vegetation in a wetland provides a substrate (roots, stems, and leaves) upon which microorganisms can grow as they break down organic materials. This community of microorganisms is known as the periphyton. The periphyton and natural chemical processes are responsible for approximately 90 percent of pollutant removal and waste breakdown. The plants remove about seven to ten percent of pollutants, and act as a carbon source for the microbes when they decay.

Major points raised during the discussion were:

- Microbial nitrification and subsequent denitrification releases nitrogen as gas to the atmosphere.
- Phosphorus is co-precipitated with iron, aluminum, and calcium compounds located in the root-bed medium.
- Suspended solids filter out as they settle in the water column in surface flow wetlands or are physically filtered out by the medium within subsurface flow wetlands.
- Harmful bacteria and viruses are reduced by filtration and adsorption by biofilms on the gravel or sand media in subsurface flow and vertical flow systems.

## Day 2: Session Details

The day started with field visit to Sewage Treatment Plant Located within the campus of Lovely Professional University. STP has a capacity of 5MLD. STP is locating next to Boys Hostel and Apartments. The visit was led by Dr. R.L. Sharma and Dr. PK Sharma and was supported by the staff present at the STP



Picture 6 Few glimpses of the STP at Lovely Professional University

## **Day 3: Session Details**

The day started with Planning and implementing of wastewater reuse projects including Scope and Demand, Types and Stages and Designated Reuse Criteria

Modern Technologies and Best Practices were discussed including Wastewater recycle and Reuse-Technology Evolution and Costs, Developments in natural sludge de-watering technology and Sludge reuse followed by Round table discussion

## **Session 6**

### **Water and Waste Water Reuse**

Ar. Lovlesh Sharma, National Institute of Urban Affairs

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This session mainly focused on water and the usage of waste water along with its necessities and origin. It began with the discussion on origin of water. 70% of the earth is covered by water. But since all of it isn't portable and is a natural resource, humans need to conserve it.

Water cycle is main source of water which has processes like precipitation, infiltration, evaporation, condensation and has different areas:

- In Natural System: This type of water cycles consists of both run-off and infiltration. Run-off is the process in which the water remained on ground after being in filtered flows off to some water body or drains.
- In an Urban Area without sustainable storm water management: This type of water cycle consists only of run-off without infiltration due to improper storm water management system. Such areas consist of only built up.
- In an Urban Area with sustainable storm water management: Such areas consist of both built up and plantations. Hence, consists of proper storm water management. These areas have evaporation due to heat been produce, along with run-off and infiltration.

The discussion further continued with benefits of treated waste water. The re-usable water is known as new water. Waste water basically, is of four types:

1. Green water: is the raw water
2. Blue water: is fit for drinking
3. Grey water: is the water that comes from toilets and requires 3<sup>rd</sup> grade treatment.
4. Black water: is the water that comes from bathrooms and kitchen.

Treatment of waste water can be centralized or decentralized. Centralized treatment consists of city as a whole whereas decentralized treatment consists of smaller area such as a neighborhood.

### **Waste water management:**

Wastewater management is the process of taking wastewater and treating/managing it in order to reduce the contaminants to acceptable levels so as to be safe for discharge into the environment.

There are effectively two basic types of wastewater treatment

- Centralised and Decentralised.
- Centralized systems are large-scale systems that gather wastewater from many users for treatment at one or a number of sites,
- Whereas decentralized systems are dealing with wastewater from individual users, or small clusters of users, at the neighborhood or small community level.
- The choice between centralized or decentralized wastewater management systems will depend upon a number of different factors, but it is important that full consideration be given to both the options rather than the situation that has existed in the past where sewerage was often considered to be the only 'proper' form of urban sanitation (UN Water, 2015). The choice between centralized or decentralized wastewater management systems will depend upon a number of different factors, but it is important that full consideration be given to both the options rather than the situation that has existed in the past where sewerage was often considered to be the only 'proper' form of urban sanitation (UN Water, 2015).



Picture 7 Session on Water and Wastewater Reuse by Ar. Lovlesh Sharma

### **Blue-Green Infrastructure**

The Concept of Blue-green Infrastructure is primarily followed in newly developed areas of Delhi with following objectives:

- As it integrates hydrological and biological water treatment trains into systems where green features are seamlessly overlapping with blue features.
- Putting together blue and green infrastructures will strengthen urban ecosystems by evoking natural processes in man-made environments and combine the demands of sustainable water and storm water management with the additional demands of water in Land pooling areas.
- Apart from Water-related benefits, Blue-green integration will have positive impacts on the urban metabolism of natural resources of Delhi and will lead to climate change adaptation and biodiversity and hence, certainly enhance the beauty and aesthetics of capital city giving additional societal benefits.
- Based upon the various parameters like topography, Soil conditions, Water table depth etc. The ideal location of waste water recharge and how they can be clubbed with green infrastructure.
- Case study of Delhi was discussed for both blue-green infrastructure and waste water management.



Picture 8 Round Table Discussion on Wastewater Management (with focus on Delhi NCT)

Today, the treatment of water is a well-known process and is executed by state of the art techniques. The sludge resulting from this process represents the next challenge for the water treatment industry, in particular the minimizing of its volume.

**Conclusion:**

Workshop proved to be helpful for the students as it provides them insight into the new upcoming technologies in the field of wastewater management. Students have tried to implement the learning in their studios like Sanitation Plans, Neighbourhood Site Planning, Local area Plans etc. Field visit to STP provided hands on experience to the students. Round table discussion on Day 3 helped in visualization of the current sanitation situation in India and students suggested several solutions based on the sessions organized on Day 1 and Field visit.