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Editorial

Treatment Wetland Can Reduce the Risk of High Soil-Water Contamination from Waste (Sewage-) Water

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A large number of impoverished communities around the country face challenges with respect to treatment of sewage and wastewater. A significantly increment in household toilet coverage across the India (~0.082 billion in September 2018 as per Ministry of Drinking Water and Sanitation) may causes high risk of microbial and organic contamination to soil-water system due to sewage water leakage from its septic tanks. In particular, the rural areas and remote communities in low socioeconomic conditions may lack conventional centralized wastewater treatment systems. As a result, in many instances, the wastewater may get disposed without appropriate treatment that contaminate drinking water resources. Even if the communities choose a low-cost system for primary treatment, such as waste stabilization ponds that do not require much operation cost and skilled supervision, the exiting wastewater does not undergo traditional secondary treatment for considerable reduction in biodegradable organic material, pathogens, nutrients, etc. from the wastewater.

Conventional treatment of sewage and wastewater by a treatment plant typically involves primary and secondary processes for removing major contaminants before disposal. However, secondary treatment of wastewater is expensive, and in developing countries the infrastructure for domestic wastewater treatment prior to disposal is poor in small cities and may be non-existent in the rural and other remote communities. In India, the discharge of untreated wastewater is the main cause for widespread pollution of surface and ground water resources since there is often a large gap between generation and treatment of domestic wastewater. For example, according to a recent report (CPCB, India, 2009), out of ~38 billion L/day of sewage/ wastewater generated, treatment capacity exists for only ~12 billion L/day in India. The problem has reached a crisis proportion as both rural and urban communities may be suffering from pathogen-related health issues due to contamination of precious drinking water sources. One third of all deaths of children under five years of age in India occur mainly due to contaminated drinking water (UNICEF, 2013). As such, there is an urgent need is to develop inexpensive and self-sustaining systems for treatment of domestic wastewater, where treated wastewater is safe for disposal. If such a system is developed for impoverished and remote, water-scarce communities in India, it can usher a dramatic change in the quality of life.

In this direction, a plot scale treatment wetland can remove several pollutants from sewage water and wastewater by plant-microbes-geochemical interactions. Such interaction significantaly enhances the 1) physical and chemical properties of polluted sites; 2) nutrient supply by root exudates; 3) the aeration by transfer the oxygen; 4) the enzymatic transformation of pollutants; 6) resistant to the migration of pollutants/pathogens. Which may help to accelarate the "biodegradtion process" of organic pollutant by native microbles causes significant removal of pollutants from sewage and domastic wastewater. The microorganisms begin to degrade the pollutants by using them as an carbon or energy source, ultimately cleaning the polluted environment. The key role in biodegradation is played by microorganisms which are very diverse in nature and comprised of bacteria, fungi, and yeast. The plant-microbes interaction is also effactively participate in "denitrification process" which may help to remove nutrient like Nitrate-N from sewage and wastewater. By taking up nitrogen friendly bacteria that live in the root zone eliminate this nutrient permanetaly from sewage and wastewater. This denitrification process in treatment wetland is crucial for maintaing soil-water quality. Wastewater containg organic hydrocarbons may used to biostimulate or enhace the potential microbes to degradate more effactively. In lab scale experiments, planted wetland shown high removal efficiency than unplanted wetlands. It has been observed that application of root zone water from planted treatment wetland

to polluted soil significantaly increases microbial popoulation and biodegradation of target pollutants. This investigations have shown that various aerobic microbial groups (heterotrophs, methanotrophs and ammonia oxidizers), active in wetland plant rhizosphere, can potentially degrade various pollutants by metabolism/cometabolism of microbes/plants.

Another advance setup named "duplex treatment wetland" is developed for the treatment of wastewater by a group of researchers including Dr. Mustapha, Dr. Gupta, Dr. Yadav and Prof. Piet Lens from IHE Delft. Duplex treatment wetland consists of vertical flow wetland having gravels for effective aeration of root zone of common reed (Phragmites australis). Aeration of wetland using solar/wind driven motors may help to maintain optimal oxygen level in root zone. Ammonia-Nitrogen and Phosphate of different concentration level is used to enhance the microbial growth and population. A horizontal bed of sand is attached to support the denitrification process to reduce the nutrients from wastewater. Experimental duplex treatment wetland shown good potential for treatment/removal of polluting constituents commonly present in the wastewater. This treatment wetland demonstrated that a significant high pollutants removal efficiency may help in polishing of sewage and wastewater in terms of organic matter, nutrients and suspended solids removal. The domestic wastewater and septic tank water discharge can be treated effectively by duplex types treatment wetlands, which offer the advantage of obtaining the highest performance levels for the wetland technology with a great reduction in size and land requirement. Duplex treatment wetland system is a self-sustaining/long-lasting, cost-effective which require minimal land and maintenance.

The outcome of this research works can support and useful to design treatment plan for sewage water and wastewater under the recent schemes like Smart Cities, Swachh Bharat Abhiyan, Namami Gange of Government of India. A large scale duplex treatment wetland can be a most advance tool for treating the discharge of wastewater from industrial units, hotels, apartments and colonies located nearby Ganga. Better implementation of treatment wetland can help to address problem of eutrophication and nutrient management of Ganga Basin. At household level, construction of treatment wetlands around the septic tank of toilets under these scheme can effectively reduce the pollution of soil-water resources, especially in shallow aquifer regions. Once can construct a treatment wetland by planting native plants and supplying domestic wastewater. Biomass produced from the constructed wetland can be used in (vermi-) composting based on the socio-economic acceptance. By implementing such effective techniques with ongoing schemes, one can improve rural sanitation, quality of soil-water resources and ecotourism.

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