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Popular Article

Dendropower for wastewater treatment and economic return

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Introduction

Dendropower stands for the strength of trees in terms of its productivity, biomass generation, quality of wood etc. Apart from this now a days these trees are also contributing in purification of water. We accomplish our energy demand through fossil fuels and non-renewable energy resources but we have to look for other alternative as these resources are limited. In such scenario we can depend on short rotation tree species like Eucalyptus, Poplar, Salix etc. for biomass energy. Although these trees with agricultural crops are irrigated with fresh water but what if these trees are irrigated with grey water (domestic waste water generated from laundry, bathing and dishwashing). Domestic waste water enriches with nitrates, phosphate, sodium and potassium when this water is used for irrigation purpose roots of plants/trees uptake pollutants from it and filter the polluted water also. These pollutants in wastewater act as nutrients for them and added benefit for yielding higher fuel wood biomass. The process that works behind the uptake of pollutants from wastewater through roots of trees and convert toxic form of pollutants present in wastewater into less toxic form is known as dendroremediation. In place of trees if plants perform the same thing that is known as Phytoremediation. The techniques involve under dendroremediation/phytoremediation are as follows:

Dendro-remediation or Phytoremediation consist of extraction, degradation, rhizofiltration, dendro-stabilization, dendro-volatilization and rhizo-degradation (Fig 1).

- Extraction: Under this technique, organic as well as inorganic contaminants are absorbed by the root hairs. This method can be applied for the resurgence of heavy metals polluted site as well as water. Although the capacity of removal of pollutants depends upon the type of species we use. Later on, after having its mature stage we can harvest it and burned in incinerator. This method is known as Phyto mining, which can be applicable for extracting mineral from ores. Although some study suggest that it is not cost friendly, through this method gold and nickel is regained in USA. In recent past, many species of Asteraceae, Laminaceae, Euphorbiacea and Brassicaceae families have been recognized with immense potential for accumulating the heavy metals.
- Dendrodegradation/ Phytodegradation: This system helps in degradation of the organic pollutants from the compounds released through trees. The enzymes present in the compound from trees have capability to degrade the harmful substances like herbicides etc. The whole process of degradation occurs without the dependance on microbes, inside the trees.
- Dendro-stabilization/ Phyto-stabilization: The roots of trees have potential to Roots of the trees have the capacity to endure the high concentration of heavy metals in contaminated water. Heavy metals can be immobilized through different methods such as sorption, sedimentation and reduction of metal valences.
- Dendro-volatilization/Phytovolatilization*:* The roots of the trees have very crucial role in sterilization of contaminated water. Roots have capacity to absorb the toxic metals via their root hairs and transform the toxic form of metals into less toxic form. Further the absorbed metals pass through vascular system and are removed by the process of transpiration or evaporation. Poplar species are well known to follow this mechanism of removal of the heavy metals. Although this method has some drawbacks of releasing heavy metals into atmosphere via volatilization or evaporation.
- Rhizo-degradation: The microbes have potential to degrade the organic pollutants present around the rhizosphere in soil or contaminated water Different compounds like fat acids,

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nucleotides amino acids, flavanone etc. are released by roots of trees, which are able to degrade the contaminants present around the rhizosphere.

- Rhizo-filtration: This method involves aquatic and terrestrial plants having strong root system. The plants are directly planted at contaminated site for treatment of contaminated water floating raft system may adopt. This method is effectual in removing radioactive substances from the contaminated water.

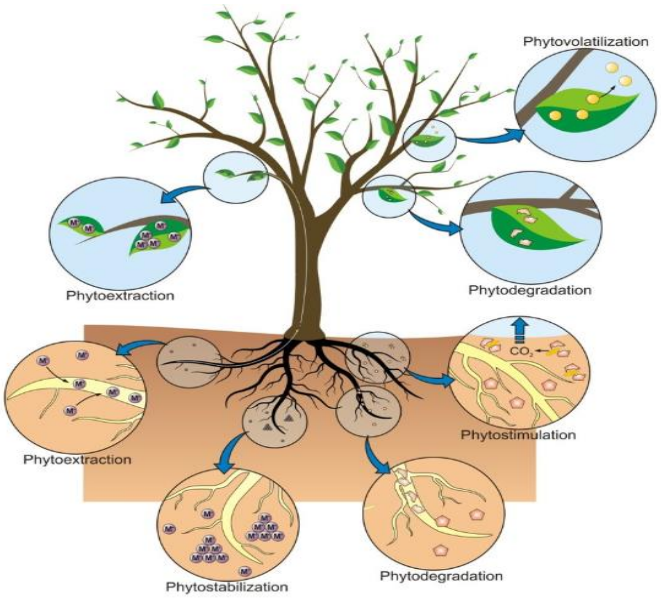

Fig.1: Dendro-remediation/Phytoremediation strategies to uptake the nutrients or pollutants (Favas et al., 2014).

Importance of Dendro-remediation:

- **More biomass production**

Fresh water accessibility is decreasing day by day due to depletion in ground water, increasing population and accelerated industrial growth. If water there will be scarcity even for drinking water, we cannot manage to irrigate our crops or trees as well with fresh water. This can cause wood scarcity in India for various commercial objectives. Approximately 200 million tons of annual fuel wood demand in India which is increasing year by year due to expansion in wood-based industries. The paper and pulp industries are deficit by inadequate supply of quality raw materials. In such condition to increase the biomass of short rotation trees, irrigation with domestic wastewater can be opted which can also fulfill the need of fertilizers in the soil. Studies have reported Eucalyptus

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hybrid k-143 has shown 25% higher biomass growth after irrigation with contaminated water as compared to fresh water irrigated trees. The biomass of Poplar and Salix trees are also doubled and quadrupled when fertigated with domestic waste water through 100 kg and 300 kg Nitrogen per hectare.

- **More economic return**

Researchers have reported impressive higher economic returns using the Dendo-remediation techniques. Trees like Eucalyptus, Poplar and Salix have shown tremendous growth using domestic waste water.

- **Purification of wastewater**

Apart from getting biomass output this system can prove effective in treatment of waste water, which is cost effective against conventional method i.e., primary and secondary methods of waste water treatments. Some study shows that *Casurina* and *Dendrocalamus* can reduce 60.7-76.2% Nitrogen, 17.7-70.3% of phosphorous and 80-94.3% of BOD from the wastewater.

Conclusion

This natural technology is like killing two birds with one stone. We can purify the wastewater as well as can get higher biomass from trees at the same time which leads to get more economic benefits.

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