Prospects of Water Hyacinth (Eichhornia Crassipes) For Environmental Remediation

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Abstract- *The worldwide worry on the issue of the pervasion of water bodies by water hyacinth (Eichhornia crassipes) has given the driving force to scientists and researchers to exploit ways of controlling its spread. It is trusted that water hyacinth is conceivably valuable. Due to presence of Water Hyacinth, depletion of supplements and oxygen from water bodies unfavorably influences the development of both plants and creatures. Subsequently transformation of this dangerous weed to esteem chemicals and fuels helps in the self-sustainability. This review is an attempt to feature its conceivable application in aqua-culture, bio-gas production, livestock feed, bin-fertilizer, wastewater treatment and as raw material for industries.*

Keywords- Sewage Scenario, Water Hyacinth, Environmental Remediation, Wastewater Treatment, Applications of Water Hyacinth

I. INTRODUCTION

Environment pollution is the serious issue that the world is facing inrecent times. In India, major problem that leads to environment pollution is exponentially risingpopulation, urbanization and industrialization. Collection, treatment and disposal of domestic and industrial wastewater are the serious issues to be handled for preventing environmental degradation. In 2016, total sewage generation in India was 61754 MLD against the developed sewage treatment capacity of 22963 MLD. Because of large gap in sewage treatment capacity and sewage generation of the country , about 38791 MLD of untreated is discharged directly into nearby water bodies (CPCB Bulletin Vol.-I, 2016), this gives rise to nutrient content of water bodies thus giving rise to phenomena called as eutrophication because of which in many water bodies there is problem of growing of water hyacinth in water bodies

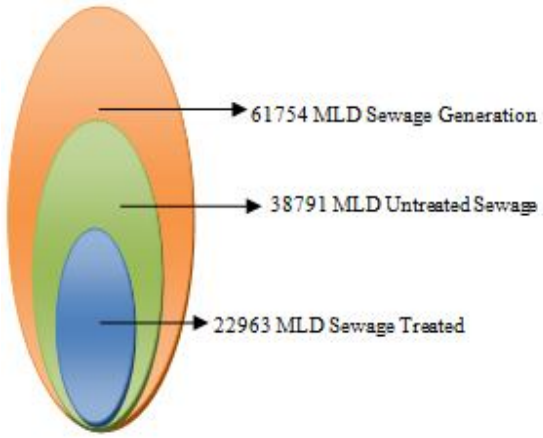


Fig 1.Sewage scenario of India

There hiatus in sewage treatment capacityand also the existing sewage treatment plants are not operated and maintained properly. The sewage generated in these areas percolates within the soil or evaporates. Sewage generated in these areas is treated using traditional wastewater treatment plant which includes processes like primary sedimentation tank, aeration unit, secondary treatment and disinfection in form of chlorination. This type of treatment plants needs high initial investment. Moreover maintenance cost is also high and treatment plant requires large land area. For the functioning and proper maintenance of the plant skilled labours are required. Overall the treatment plants are costly affair and results are not up to the mark. Treatment of wastewater by traditional method is very costly and hence neglected by most of the public work departments. The main objective of this study is to develop cost effective treatment technology for sewage treatment. Assessment of root zone technology for sewage treatment and disposal is conducted.

The wastewater course through the root zone is in level or vertical way, where the natural toxins are decayed biochemically by the microscopic organisms found in the rhizosphere of root plants. The filter media are chosen precisely to give good conditions to both the plants and bacterial development and to abstain it from stopping up. Organic pollutants are removed drastically from wastewater and are reduced to their elemental forms. It also has potential to accumulate heavy metals in the root zone. The root zone

treatment systems have wide range of applications in treatment of different types of wastewaters such as domestic and industrial waste water containing biodegradable matter including some, which are difficult to treat by other means. There are many advantages of utilizing root zone technology, for example, takes low capital costs, low working and upkeep costs, no need of specialized manpower, environmentally safe and friendly method.

II. WATER HYACINTH

Water hyacinth (WH) is a free floating, perennial aquatic plant originated from Amazon river basin and have distributed throughout the world. It has exhibited extremely high growth rates and the coverage of waterways by WH has created several problems including destruction of eco systems, irrigation problems and also as a mosquito breeding place leading to increase in mosquito population (Sornvoraweat and Kongkiattikajorn, 2011). For a long time water hyacinth has been used as a decorative product because of its appealing appearance. Water hyacinth was likewise presented as the intrusive and free-skimming oceanic macrophyte by numerous botanists. It is an individual from the family Pontederiaceae which is indigenous to Brazil, the Amazon basin and Ecuador locale (Tellez et al., 2008).The development of this plant on the surface of water can lessen the penetration of daylight into the water. Daylight is key for some photosynthetic life forms, lessening daylight implies decreasing the develop rate of photosynthetic creatures and in the meantime disturbing the natural balance (Tiwari et al., 2007).Water hyacinth has long roots which are suspended in water. The root structure of oceanic plants specifically water hyacinth can show reasonable condition for the oxygen consuming microorganisms to work in the sewage framework. Aerobic microorganisms utilize the natural nutrient and supplement present in the wastewater and change over them into inorganic mixes, which can be used by the plants (Gopal, 1987). The individual plants are of moderate size, measuring perhaps 50cm from root tip to the top of the flower cluster. . They have long, spongy and bulbous stalks. The feathery, freely hanging roots are purple-black in colour. Typical weight is of the order of 1 kg, of which some 95 percent is water.

Fig 2. Morphology of water hyacinth plants
(Parsons and Cuthbertson, 2001)

ar: adventitious root; dp: daughter plant; in: inflorescence; lb: leaf blade; li: leaf isthmus; pf: peduncle of flower spike; pt: petiole; rt: root; st: stolon.

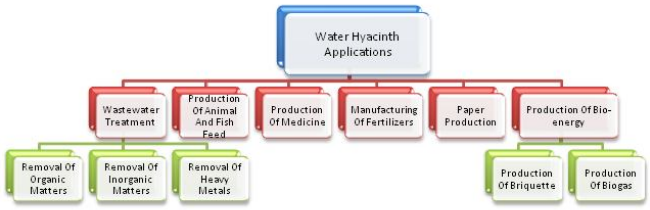
Water Hyacinth contains almost 20% of cellulose, 48% of hemicelluloses and 3.5% of lignin. The high hemicellulose and cellulose content of the WH can be explored for the production of various value added products and biofuels. Since the productivity is very high it could be utilized as a feed stock for the production of biofuels. WH has several advantages like it can grow on water without competing against arable land for growing grains and vegetables. Several reports are available for the conversion of WH to fuel ethanol and biogas (Okewale et al., 2016; Gunja et al., 2016; Das et al., 2016; Shah et al., 2015).The potential of WH for the removal of pollutants is a well-established environmental protection technique and it functions like “natures kidney” for removal of toxic compounds from water resources of earth. The biosorption potential of WH has been exploited for the removal of various heavy metals and pigments from various industrial effluents. Growing of WH in industrial effluents leads to decrease of total suspended solids (TSD), chemical oxygen demand (COD) as well as biological oxygen demand (BOD). The mechanism involved in biosorption is by extracellular accumulation/precipitation, cell surface sorption/precipitation and intracellular accumulation (Rai et al., 2002). Phytoremediation using Water Hyacinth is cost effective and eco-friendly process.

Biological classification of the common water hyacinth

Kingdom: *Plantae*
Subkingdom: *Tracheobionta*
Superdivision: *Spermatophyta*
Division: *Magnoliophyta*
Order: *Liliales*
Family: *Pontederiaceae*
Class: *Liliopsida*
Subclass: *Lilidae*
Genus: *Eichhornia*
Species: *crassipes*

III. APPLICATIONS OF WATER HYACINTH

Wastewater treatment: Water Hyacinth has potential to remove all physical, biological and chemical pollutants from both domestic and industrial wastewater. It is economical method of treating wastewater. Phytoremediation using aquatic macrophytes seems as a promising strategy for the removal of pollutants and contaminants from various natural sources. WH has been widely used for the rapid removal of various kinds of pollutants from water due to it's easily availability, effectiveness as well as its capability to remove a wide range of pollutants. Phytoremediation of metals contaminated distillery effluent using Water Hyacinth (Bathla, 2016).



Production of Animal And Fish Feed: Several studies are going on for the development of supplementary feed for cost effective substitution of high cost fish meal with cost effective protein source. Aquatic macrophytes have been used as supplementary feed in fish farming. WH can be used as a source for fish feed. Nutritional value of WH leaves fermented with Bacillus subtilis CY5 and Bacillus megaterium CI3 (Saha and Ray, 2011)

Production of Medicine: In the wake of cleaning the plant altogether, the decoction of the entire plant is utilized to deal with blood issue, starvation, and shortcoming. The decoction is utilized to treat goiter. Be that as it may, alongside this decoction, a poultice is set up from the crushed plant and applied onto the infected portion of the neck.

Manufacturing of Fertilizers: Bio-fertilizers are organic material of natural origin and which provides one or more nutrients to plants essential for their growth. One of the mostly available strategies for soil fertility remediation is the use of weeds. The study conducted by Vidya and Girish, 2014 revealed that WH can be used as a bio-fertilizer when incorporating to soil increased the performance of wheat plant. The study revealed that both physical and chemical parameters had higher values as compared to control. WH is a good absorber of N, P and K from the water and can be used as a compost material. The results indicate the potential of WH as organic manure.

Paper Production: There are two fixings that are irreplaceable for making paper i.e water and fiber. Without water there is no paper. We can beat filaments till we're blue in the face, however until the point that they are suspended openly in water, it's difficult to shape paper from them. Fiber is available in all parts of the plant kingdom. Synthetically the plant strands comprise of cellulose, which frames the principle constituent of the cell wall. The fibers are available in various parts of the plant: the stem, the leaf and the natural product. With a specific end goal to make the plant fiber appropriate for the production of paper the fiber must be rendered dis-solvable: the recovery or extraction process.

Production of Bio-energy: Water Hyacinth is used for production of Briquette and biogas

- **Briquette**: Increase in energy demand has raised concerns about the economic and environmental impacts of power generation based of each nation's energy source. Briquetting of abundant biomass is one of the possible solutions to overcome the local energy shortages in the country. WH will be an ideal source for preparation of fuel briquettes. Compared to wood or other fuel briquettes WH has a lesser cultivation and preparation cost (Rezania et al., 2015).
- **Biogas**: Biogas is a gas mixture produced by the anaerobic fermentation of organic materials by methanogenic bacteria. It consists of a mixture of methane, carbon dioxide, water, hydrogen sulphide and ammonia. WH serves as a potential source for biogas production. Several reports were available for the potential of WH as a raw material for the production of biogas. Anaerobic co-digestion of WH along with cow dung and elephant grass for biogas production at laboratory scale (Okewale et al., 2016). The plant grows well in diluted paper mill and highly acidic distillery

effluents and takes up heavy metals and other toxic materials for their growth. Utilization of the slurry of WH used for phytoremediation produced significantly more biogas than that of plants grown in deionized water. Maximum biogas production was observed in 9-12 days (Singhal and Rai, 2003)

IV. CONCLUSION

Water hyacinth which is regarded as major point of problem for municipal corporation authorities, is in fact a boon for mankind if used wisely. Water hyacinth has following major applications:

1. Water hyacinth can be used in treating domestic wastewater as a Low cost Wastewater treatment.
2. Water hyacinth can be used to generate Bio-Energy
3. Water hyacinth can be used for manufacturing of Medicines, Paper, Animal Feed and Fertilizers

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