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Water Quality Improvement through Macrophytes: A Case Study

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Abstract : Macrophytes play important roles in balancing lake ecosystem. They have capacity to improve the water quality by absorbing nutrients with their effective root system. The objective of the study is to evaluate the usefulness of different macrophytic species (Biofilters) in reducing the nutrient content of the water *i.e.* to reduce the pollution level of water. The paper is the outcome of *ex-situ* experiments conducted on samples collected from Shahpura Lake, Bhopal. Two macrophyteic Species *Eicchornia crassipes* and *Hydrilla verticillata.* Results indicates that both the macrophytes are capable in improving water quality by reducing nutrient concentration. Purification of water through macrophytes is a good example of purification of water with natural means.

Key words : Macrophytes, Lake Ecosystem, *Eicchornia crassipes, Hydrilla verticella*

Introduction

Macrophytes are common features of an aquatic ecosystem. Accumulation of nutrients in an aquatic ecosystem leads to eutrophication resulting into massive growth of the macrophytes and weeds. Main cause of nutrient accumulation is rapid urbanization and anthropogenic pressure. Storm water runoff and discharge of sewage into the lakes are two common ways that various nutrients enter the aquatic eco-system, resulting into the death of those systems (Sudhira and Kumar, 2000). The washing of large amount of clothes by dhobis, laundry workers, and continued entry of domestic sewage in some area death and decay of macrophytes are posing pollution problems. The water quality issues regarding lakes everywhere, eutrophication is of great concern. Eutrophication of a water body signifies the aging of a lake. It is caused by the accumulation of nutrients, sediments, silt and organic matter in the lake from the surrounding watershed.

Macrophytic vegetation plays an important role in maintaining the ecosystem of a lake. Various types of macrophytes emergent, free floating, submerged are generally observed in an aquatic ecosystem.

Free floating macrophytes leaves & roots are floating; roots are not attached in sediment. *Eicchornia crassipes* is free floating aquatic plant in which roots play important role in removing nutrients (Reed *et al., 1995*). It has tremendous capacity of absorbing nutrients and other substances from the water (Boyed, 1970) and hence brings the pollution load down. It is found to be most effective in removal of BOD, COD, nitrogen, phosphorus, organic carbon, suspended solids, phenols, pesticides, heavy

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metals etc from waste water (Gupta, 1982). In 1977 Wolverton B.C. and McDonald suggested that water hyacinth (*Eicchornia crassipes*) can be utilized in wastewater treatment.

In *Hydrilla verticillata* (submerged macrophyte) the whole plant plays an important role in absorbing nutrients and grows well in oxygenated water; therefore it cannot be used in treating wastewater high in the BOD. They have more area for attachment for denitrifying bacteria then emergent macrophytes (Weisner *et al.*, 1994).

In India, almost all the water resources are occupied with various types of macrophytes viz. rooted shoreline, free floating and submerged etc, which are an integral part of the ecosystem and acts as bio-filters. As we know conventional treatment process is very costly with high operational and maintenances cost therefore efforts are for the use of natural devices, which can be used as an eco-friendly and effective source of treatment.

The need of the study is because of the deterioration of water quality of Shahapura Lake day by day. Accumulation of residential waste, toxic chemicals and sediments are very common. Due to excessive pollution load massive growth of macrophytes are commonly seen. Commonly found macrophytes are *Eichhornia crassipes*, *Hydrilla sp.* verticillata. The purpose of the study is to utilize these macrophytes as bio-filters and to observe efficiency of various macrophytes to remove pollutants available in lake.

Materials and Methods

The present study was conducted in water of Shahapura Lake (Mansarover Lake) of Bhopal city. The Lake is situated in the center of Bhopal city, the state capital of Madhya Pradesh India (latitude 23°12'00"E and longitude 77°25'30"N). The lake is a shallow aquatic ecosystem mostly muddy due to accumulation of silt. The main inlet joins at northern end, through which maximum sewage inflows into the lake.

Two *ex-situ* studies were conducted by taking two *Macrophytes, Eicchornia crassipes* and *Hydrilla verticillata*. For observing the rate of nutrient uptake big water container (approx. 5.0 liters) is required. Add 2.0 liters of raw water from inlet and introduce 100 grams of *Eicchornia crassipes*. Observe initial concentration of nutrients in raw inlet sample. Collect the samples at regular intervals of one week and observe nutrient concentration.

Similar experiment was also conducted by taking macrophytes *Hydrilla verticillata* as a bio-filter.

Samples at regular interval were collected from *ex-situ* experiment set ups. Water quality parameters were analysed by standard methods given in APHA (1999) 19th edition.

Results and Discussion

(A) *Ex-Situ* Experiment for nutrient uptake by *Hydrilla verticillata*

The nutrient rich water *i.e.* raw sewage was taken as liquid media for experiment. *Hydrilla verticillata* shows affection towards phosphate, nitrate, sodium and potassium ions in large amounts. The aquatic plants absorb the major plant nutrients like nitrogen and phosphorus that is also major pollutants of the domestic wastewater for luxuriant growth. There is a great reduction in nitrate (57.68%). BOD & COD both reduces by (37.5 %). Other parameters like

Fig. 1: Percentage Reducton in Various Parameters Using *Hydrilla verticillata*

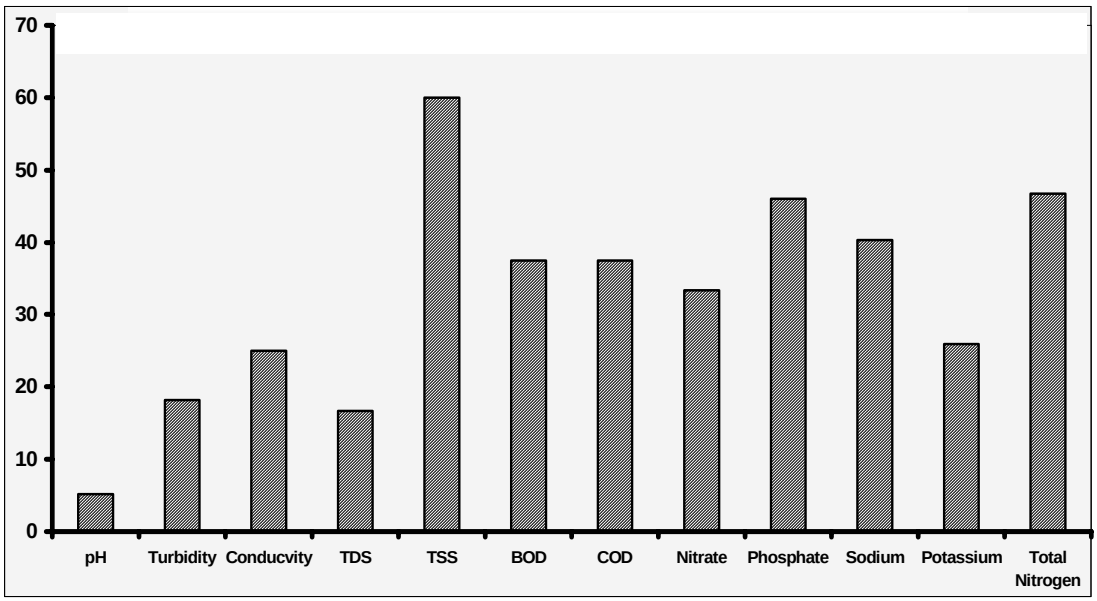
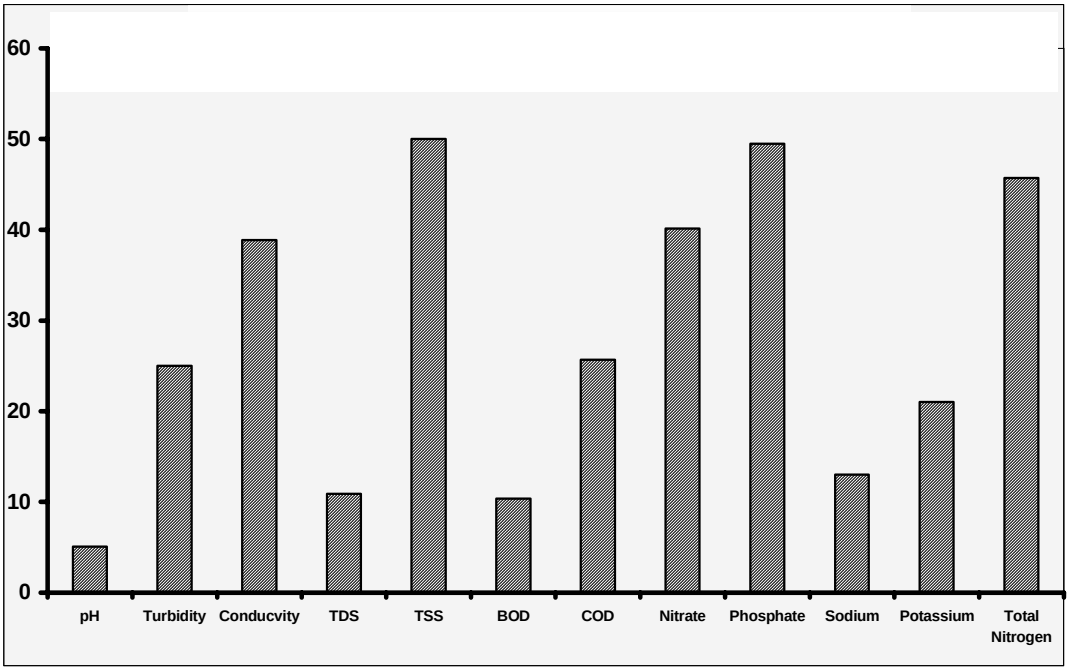


Fig. 2: Percentage Reducton in Various Parameters Using *Eicchorneia crassipes*



pH, TDS, TSS etc also reduces by using *Hydriila verticella*. The actual reduction in percentage we can see in Fig.1

(B) *Ex-Situ* Experiment for nutrient uptake by *Ecchornia crassipes*.

Ecchornia crassipes is very common macrophytes of Indian wetland. It is a good bio-filter. It is efficient to reduce conductivity by (38.88 %), turbidity by (25%), TSS by (50%). The detailed percentage reduction can be noted in Fig.2.

Ecchornia crassipes (Water Hyacinth) regarded as world's worst weeds (Russel, 1987). High productivity and resilience of the weed make them ideal macrophytes for wastewater treatment.

Conclusion

The self-purification of wetlands can be largely attributed to the macrophytic vegetation. This ability of macrophyte to absorb nutrient in large quantities can be utilized for wastewater treatment.

Eichhornia crassipes is efficient in reducing COD, TSS, Nitrate, and Phosphate.

Hydrilla verticillata can be used as a better bio-filter for phosphorus. There is great reduction in TSS (60%), BOD and COD are reduced by 37.5%, nitrate is reduced by 33.41%, and phosphate is reduced by 46.01 %. Weisner (1994) observed that *Hydrilla verticillata* grow well in oxygenated water and therefore cannot be used in treating wastewater high in the BOD. High oxygen concentration also creates favorable conditions for the mineralization of organic matter and thus help in reduction of BOD.

For non-point source of pollution, the root zone method of wastewater treatment is most suitable. The technology is cost effective, maintenance free, self-sustained and Eco-friendly.

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