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The Phytoremediation Quality of Macrophytes of Dheer Beel in Dhubri District of Assam

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Abstract

The flood plain wetlands constitute important fishery resources of Assam. Specially, in Lower Assam the wetlands provide an extreme Biodiversity spot for different floral and faunal population. Dheer beel is a water body situated in the Chapar-Salkocha Sub-division of Dhubri District. It is characterized as a floodplain wetland. The beel constitutes a vast diversity of macrophytic population. Phytoremediation in the biotechnology use of green plants as Bioremediators including marshy plants like *latifolia*, *Lemna* sp. *Pistia* sp. etc. to remove, contain or render harmless such environmental contaminant as trace elements and organic compounds in soil and water. In the present study, Phytoremediation takes advantages of the unique and selective up take capabilities of plant root system together with the translocation, bio accumulation and contaminant storage. It is evident from the study that aquatic macrophytes are efficient tool for contaminant removal. They removes not only lead, but mercury, cadmium and chromium from bogs and wetlands, and makes a lovely ground cover for muddy shores. There are so many Phytoplanktons which are available in the Dheer beel and are useful for Phytoremediation. Thus, present study reveals the bioremediator plant diversity of Dheer beel and in its adjacent areas.

Keywords: Bio Accumulation; Macrophytes; Phytoremediation; Bioremediators.

Introduction

Phytoremediation is the use of selected crop plants or trees to extract or promote degradation of toxic substances in soils, ground water, surface water, wastewater and sediments. It may be possible in some cases to harvest such contaminants as heavy metals that have been taken up by plants and recover them for recycling. In other variations, plants stimulate the growth of naturally occurring microbial populations, which then degrade organic contaminants, such as petroleum hydrocarbons, in soils. At appropriate sites, the cost of applying Phytoremediation techniques may range from half to less than 20% of the cost of using physical, chemical, or thermal techniques.

One of the burning problems of our industrial society is the high consumption of water and the high demand for clean drinking water. Numerous approaches have been taken to reduce water consumption, but in the long run it seems only possible to recycle wastewater into high quality water. Phytoremediation has probably a large potential for treatment of pollutants in the environment, even if today, plants are not widely used. Studies were conducted in order to determine technical and economical feasibility of phytoremediation processes for full-scale treatment, including rhizofiltration (use of plant to accumulate compounds from aqueous solutions into roots), phytostimulation (use of plant to stimulate naturally occurring microbial degradation), phytostabilization (use of plant to prevent compounds from mobilizing or leaching in soil) and phytoextraction (use of plant to remove contaminants from soils into plant roots or shoots). One of the greatest advantages of phytoremediation is its lower cost than other competing technologies. In addition to cost, phytoremediation offers other advantages: it is a non destructive in-situ technology applicable to a variety of contaminants; it is capable of remediating the bioavailability fraction of pollutants and accumulating heavy metals (Cu, Co, Ni, Zn, Cd, and Pb). Plants are seasonally dependent and hyper accumulator plant species can also have a very low growth rate, making necessary to select new varieties capable of hyper accumulation with high biomass production. Among disadvantages are the fact that phytoremediation is not applicable to mixed wastes or to high concentrations of pollutants. It also requires large available surface area and it is applicable only to surface soils. One of the

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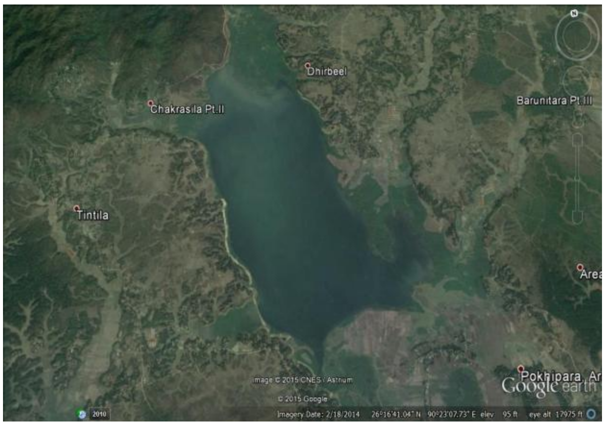
major problems is the need, in some cases, to harvest the biomass and to dispose it as hazardous waste.

Study Area: Dheer Beel, Chapar-Salkocha, Division, Dist.-Dhubri (Assam).

Map Coordinates: 26°16'21.68" N & 90°22'46.40" E



Aims & Objectives

There is also a lack of recognized economic performance data and the potential market seems to be very confidential today. Further research and development efforts are then necessary to increase remediation performances and to reduce treatment time, especially for high concentration pollutions or complex pollutions with mixtures of heavy metals and/or organic compounds. Alicia *et al*. reported that the roots of some aquatic plants could retain both coarse and fine particulate organic materials present in water bodies supporting their growth. Plants sustain large microbial population in the rhizosphere by rhizo-deposition, root cap cells, which protect the root from abrasion, may be lost to the soil at a rate of 10000 cells per plant. In addition, root cells excrete mucigel, a gelatinous substance that is a lubricant for root penetration through the soil during growth and microbes in the root zone can help to solublise insoluble nutrients and recycle organically bound nutritive elements.

Phytoremediation is a promising technology which is used in many developed countries for removing various pollutants from the industrial effluents. BOD from the industrial effluents has been effectively removed by phytoremediation. The average overall treatment efficiency for COD removal was high with wetland treatment technology for industrial effluents. Gudekar and Trivedi reported 59.54 per cent reduction of turbidity in treatment of engineering industry waste with water hyacinth. Reduction of total dissolved solids from acid mine drainage from a uranium deposit and pulp and paper industrial wastewater by means of a natural wetland. The effluent nutrients also can be effectively removed by constructed wetland technology. Karavaiko reported reduction of total β-activity, from influent 2.80 Bq/l to less than 0.5 Bq/l of radionuclide polluted mine waters by aquatic macrophytes.

Methodology

1. Primary Source-Visiting to the Beel site weekly and collection of water sample.
2. Water analysis from different site of the Beel and 500 ml of water is taken to study its physico-chemical characteristics in laboratory.
3. Secondary Source-Phytoplanktons are also collected and identified through literature and information from Pollution Control Board.

At first we selected the five areas in the whole Dheer Beel area. The plants used for the experiment are: Emergent plants like *Lemna* sp., floating plants like *Azolla*, *Polyrhiza*. For treatments, the respective plants which were maintained in those areas were collected, cleaned and blotted. Approximately 250g each experimental plant used for the study, each occupying half of craits, were carefully introduced into the treatment containers. 500ml each of water and effluent samples from the respective site were collected periodically for analyzing the changes in its physico-chemical characteristics. Initial analysis of plant, soil and effluent were done according to Standard Methods. The effluents were added in various concentrations to the beel area. After 15 days of effluent addition to plants, water and soil samples were analyzed for physico-chemical and biological characteristics viz pH, temperature, COD(Chemical Oxygen Demand), BOD (Biochemical Oxygen Demand), TOC (Total Organic Carbon), TSS (Total Suspended Solids), TDS (Total Dissolved Solids) and emission of plants. The variations in the values of plant, soil and water samples from the primary data were noted.

Photo:- Common Macrophytes of Dheer Beel

Results of the Study

The effluent characteristics before and after treatment in both emergent plant and free-floating plant was noted. The results are presented hereunder.

Table - 1

Changes in Site-I Effluent Parameters in a *Lemna* spp.

Parameters	Influent	Effluent	% Change
TSS (mg/l)	17	9	47.06
COD (mg/l)	54.6	20.6	62.27
BOD (mg/l)	13.6	3.2	76.47
TOC (mg/l)	12	8	33.3
pH	7.8	7	10.26
salinity (ppt)	0.875	0.635	27.43

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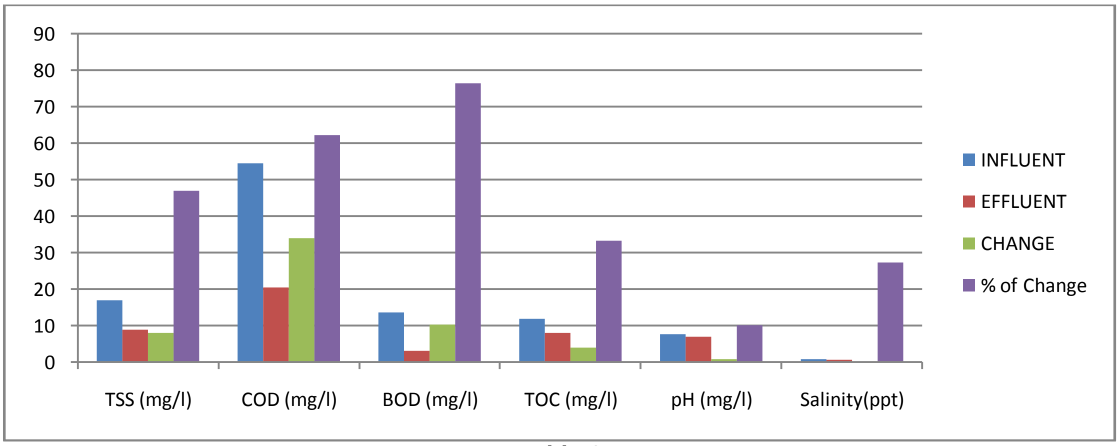


Table-2

Changes in Site-II Effluent Characteristics in a Polyrhiza

Parameters	Influent	Effluent	% Change
TSS (mg/l)	120	16	86.67
COD (mg/l)	530	476	89.81
BOD (mg/l)	235	26	88.94
TOC (mg/l)	34	14	58.82
pH	4.3	6.6	53.49
salinity (ppt)	0.764	0.554	27.49

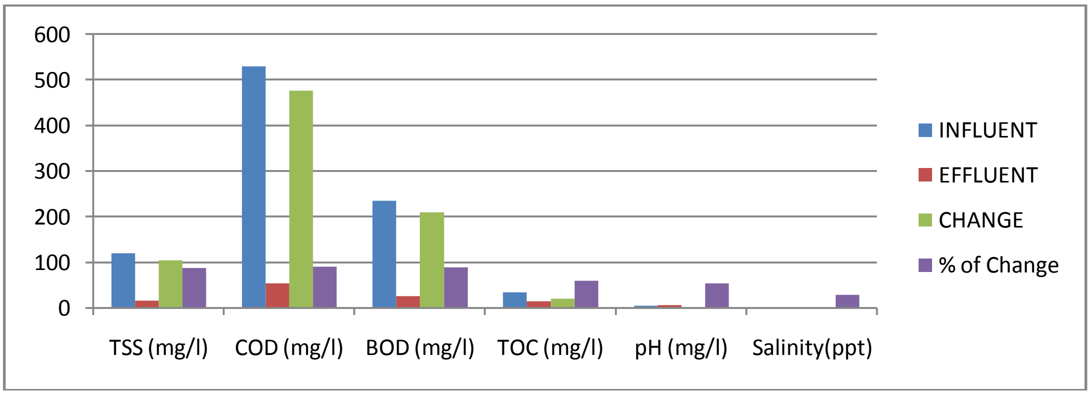


Table- 3

Changes in Site-III Effluent Characteristics by Azolla (free-floating)

Parameters	Influent	Effluent	% of Changes
TSS (mg/l)	29	16	44.83
COD (mg/l)	60.5	30.1	50.25
BOD (mg/l)	14.4	8.2	43.06
TOC (mg/l)	16	7	56.25
pH	7.6	6.6	13.16
salinity (ppt)	0.658	0.454	31.00

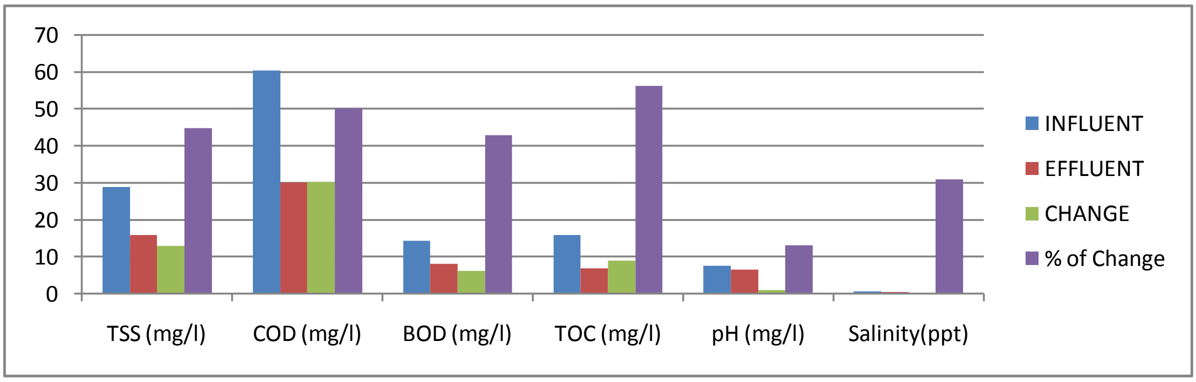


Table - 4
Changes in Site-IV Effluent Characteristics in an Azolla (Free-floating)

Parameters	Influent	Effluent	% Change
TSS (mg/l)	158	36	77.22
COD (mg/l)	560	98	82.50
BOD (mg/l)	18	9.5	47.22
TOC (mg/l)	35	15	57.14
pH	4.58	5.8	28.89
salinity (ppt)	0.658	0.428	34.95

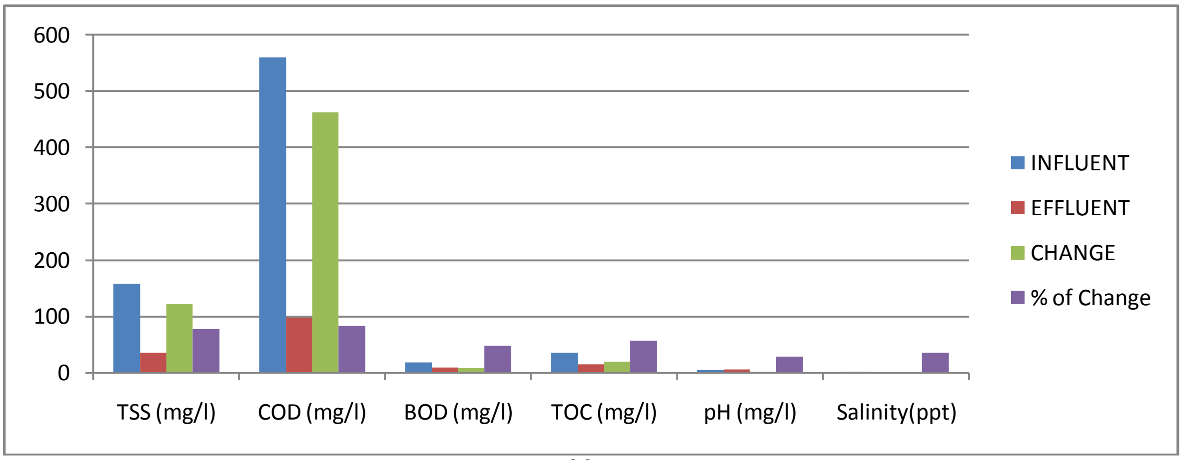


Table - 5
Changes in Site-V Effluent Characteristics in a Lemna (free-floating)

Parameters	Influent	Effluent	% Reduction
TSS (mg/l)	29	12	58.62
COD (mg/l)	40.5	25.2	37.78
BOD (mg/l)	14.4	6.3	56.25
TOC (mg/l)	14	12	14.29
pH	5.6	7.1	1.5
salinity (ppt)	0.954	0.934	18.16

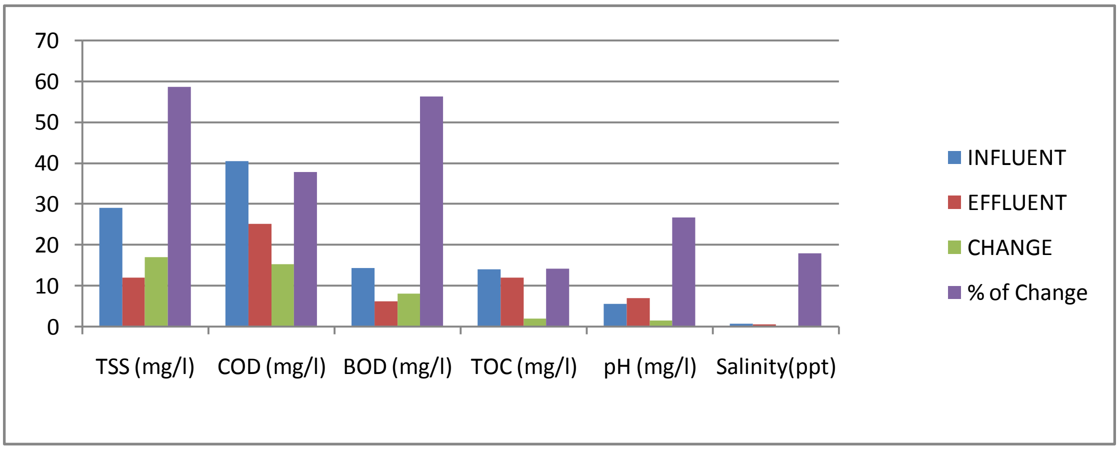
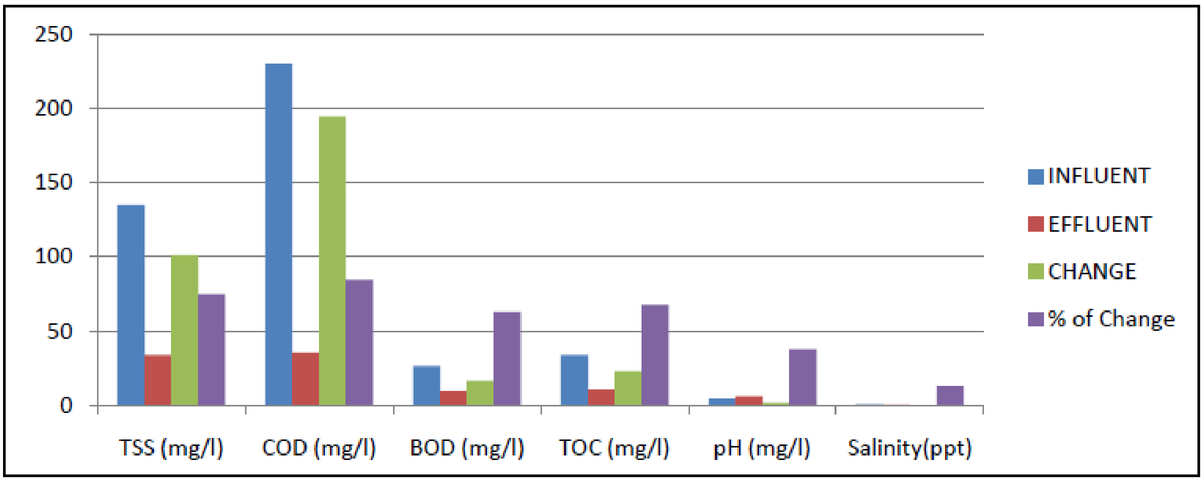


Table- 6
Changes in Site-V Characteristics in a Lemna (Free-floating)

Parameters	Influent	Effluent	% Reduction
TSS (mg/l)	135	34	74.81
COD (mg/l)	230	35.51	84.56
BOD (mg/l)	26.4	9.8	62.88
TOC (mg/l)	34	11	67.65
pH	4.5	6.2	37.78
Salinity (ppt)	0.62	0.54	12.90



Efficiency of *Lemna* sp. (Emergent) Based on Selected Area

The results of the study of changes in Site-I effluent characteristics using Lemna spp. is provided in Table I. The system showed an overall BOD removal of 76. 47%. 47. 06% of total solids were removed. The pH was also reduced for alkaline nature to neutral. The changes in Site-III effluent due to remediation using Polyrhiza is given in Table II. This system was found to work more effectively with site- I effluent compared to Site-III effluent. The TSS removal was upto 87%. 89% of BOD and COD were removed using this system. The pH of Site-IV effluent (initial) was highly acidic. But after treatment, pH increased to 5.8

Efficiency of Azolla (free-floating)

Changes in Site-III effluent characteristics when treated with *Azolla* are provided in Table III. A moderate reduction in the pollutant concentration was observed. 44.83% of TSS, 50.25% of COD. The Site-IV effluent parameters showed a drastic change after treatment. 86.5% of TSS and 88% BOD were reduced. Azolla (free floating) proved to be a positive results for organic matter removal. Changes in Site-IV effluent characteristics when treated with Azolla (free floating) are provided in Table IV.

Efficiency of Lemna (free-floating)

Lemna showed moderate removal of pollutants in the Site-V effluent (Table V). 37.78% of COD and TSS upto 58.62%. However, Lemna (free floating) was found to be more efficient in the treatment of Site-V effluent (Table. VI). 84.56% COD, 62.88% BOD and TSS upto 74.81%.

Discussion

These natural beels are capable of achieving a high efficiency of suspended solids removal from the water column. Suspended matter in the water may contain a number of types of contaminants, such as nutrients, heavy metals and organic compounds. These contaminants may themselves be in particulate form, or they may be physically or chemically bound to the particulate matter. Thus, in cases where the bulk of the contaminant load is associated with particulate matter, physical settling of suspended solids can result in efficient removal of the contaminants from the water or wastewater stream. The removal percentages of TSS in the present study agree with the study of *Haris*. The present review highlights the phytoaccumulation potential of macrophytes with emphasis on utilization of Azolla as a promising candidate for phytoremediation. The impact of uptake of heavy metals on morphology and metabolic processes of Azolla has also been discussed for a better understanding and utilization of this symbiotic association in the field of phytoremediation.

Pistia stratiotes, also known as Jalkumbhi, is an aquatic plant, stoloniferous, floating on lakes, streams, and stagnant water ponds and in lime-rich water, throughout India. The BOD of the effluent was reduced significantly after the treatment in all the effluents by the emergent plant. Tegegne *et al*. and Kirzhner *et al*. noticed significance decrease in the concentration of BOD when the effluents from various industries were treated with constructed wetlands. Recent studies by Adeola *et al*. reported significant reductions in the biochemical oxygen demand throughout the system with levels decreasing across the selected areas in the Beel. The reduction in BOD and COD can be attributed to many reasons. Aquatic plants have the unique feature of transporting oxygen from the aerial plant portions to the submerged parts of the plant and the oxygen transported by aquatic plants significantly increase the sub canopy oxygen content of the water. By providing green surfaces, the Phytoremediation process is environmentally friendly and cost-effective. By using wetlands it can be applied in waste water treatment indicate a new technical-technological solution for nature protection and environment conservation. The operation is inexpensive and energy-saving, since it is dominated by natural processes and does not require air or oxygen.

In most developing countries like India, the treatment process lack of effective environmental pollution control laws or law enforcement. An additional benefit gained by using wetlands for waste water treatment is the multipurpose sustainable utilization of the facility to uses such as swamp fisheries, biomass production and scientific study. Being low cost and low technology system wetlands are potential alternative or supplementary system for waste water treatment in countries like India.

Conclusion

The Beel wetlands may be an economical option for secondary treatment of stabilization pond effluent, the most common treatment system to be use in economically poor countries. Given the tropical location of many developing nation, wetlands may be successfully established with plant species acclimated to the tropical environment and able to be harvested for the use in secondary function like fuel production. Cost environmental impact and management consequences must be evaluated for each community considering the potential application of this treatment technology. Due to Industrial growth different types of pollutants has been introducing numerous hazardous compounds into the environment at an exponential rate. These hazardous pollutants consist of variety of organic compounds and heavy metals and radioactive waste. Heavy metals are primarily a concern because they cannot be destroyed by degradation. From our present study we can observe that there is a change in the concentration of these harmful substances can be removed by these plants. So, the Macrophytic plants has a lots of phytoremedial characteristics. Here we have put just the preliminary idea regarding our observation in Beels.

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