



## Physicochemical Parameters And Phytoremediation Of Water Samples Of Laxmitaal Jhansi

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### ABSTRACT

Water being the source of life is vital for all known forms of life. It is an excellent solvent used for all purposes of life like drinking, cooking, agriculture, industries etc and so its availability is decreasing. For the limited resource availability, reuse of the available supply is more suggestible. To maintain this, pollution factors in water bodies should be on regular check and if pollution exceeds it should be remediated. Many physical and chemical technologies prevail for remediation of water, but Phytoremediation is the best technique. This is a very eco-friendly technique which decontaminates the wastewater in a very economical way. The present study emphasise on Physico-chemical parameters measurement and heavy metal detection in LaxmiTaal, a local water body in Jhansi city of Uttar Pradesh. Physicochemical parameters like pH, turbidity, alkalinity, chloride content, total dissolved solids, BOD, DO and COD are measured every six months to observe the seasonal variations. Phytoremediation efficiency of *Eichhornia* and *Hydrilla* is examined by treating contaminated water of Laxmi Taal. The results revealed that many of the physicochemical parameters of Laxmi Taal water were in the range of pollution but after phytoremediation water quality is enhanced as the parameters towards pollution were greatly reduced.

**Key words:** Physico-chemical parameters, phytoremediation, *Eichhornia*, *Hydrilla*.

### INTRODUCTION

Mother Earth is endowed with extraordinarily diverse and distinctive traditional waterbodies found in different parts of the country, known as ponds, lakes, taals, ahars, bawdis, talabs and others. These water bodies maintain and restore the ecological balance. They act as sources of drinking water, recharge groundwater, control floods, support biodiversity, and provide livelihood to large number of people, animals and microbes. Jhansi, the Gateway to Bundelkhand region is well known city which lies between 24° 11' N to 25° 57' N latitude and 78° 7' E to 79° 23' E longitude, situated in south western part of Uttar Pradesh. Laxmi Bai Taal is the three centuries old water body present in central part of Jhansi city.

In the last few decades, waterbodies have been under continuous and unrelenting stress, caused primarily by rapid urbanisation and unplanned growth. Waterbodies are being polluted by untreated effluents and sewage that are continuously being dumped into them. Wastewater is generated from the industrial, domestic, commercial and agricultural sectors [1,2]. Untreated wastewater contains various types of pollutants consisting of organic and inorganic materials with different concentrations [3,4]. Rapid industrialization and indiscriminate use of chemical fertilizers and pesticides in agriculture are causing heavy and varied pollution in aquatic environment leading to deterioration of water quality and depletion of aquatic biota [5,6,7]. The decline in both the quality and quantity of these waterbodies is to the extent that their potential to render various economic and environmental services has reduced drastically [8,9,10]. Therefore it is necessary to check the quality of water in these water bodies at regular intervals.

It is of utmost importance for meeting the rising demand for water augmentation, improving the health of waterbodies as they provide various ecosystem services that are required to manage microclimate, biodiversity and nutrient cycling. Thus it requires water quality to be maintained. Remediation of water can be done by many physical and chemical methods involving reverse osmosis, filtration, adsorption, coagulation, flocculation and oxidation [11], but as they are very costly, labour intensive and exhausting methods as they cause secondary pollution and high sludge production [12,13]. Thus the biological approaches like phytoremediation is taken into consideration for eco-friendly remediation of water. Phytoremediation is an emerging, reliable, less expensive, aesthetically valued, and green approach that applies plants for the treatment of contaminated water and soil [14]. Naturally, plants are involved in some specific enzymatic pathways to degrade complex compounds to non-toxic compounds which reduce the pollution effect of contaminated areas [15]. Plants uptake the pollutants present in the contaminated environment through the root system and facilitate detoxification or degradation and/or accumulate pollutants via various plant mechanisms such as phytoextraction, rhizofiltration, phytostabilization, phytotransformation, rhizodegradation and the phyto-volatilization process [16,17]. Thus it is a cost effective, sustainable, less labour intensive, more efficient and publicly accepted method. Aquatic plants are widely used for the remediation of contaminated water due to their rapid growth, higher yield of plant biomass, and having toxic tolerant capability [18,19]. *Eichhornia crassipes* [20], *Salvinia molesta* [21], *Salvinia cucullata* [22], *Lemna minor* [23] and *Pistia stratiotes* [24] are the water plants widely used for the treatment of wastewater. The present study aimed to investigate the phytoremediation of water collected from the main water body of Jhansi city Laxmi Taal. Phytoremediation efficiency was checked for two aquatic plants i.e. *Eichhornia crassipes* and *Hydrilla verticillata*.

## MATERIALS AND METHODS

### Description of Study Area

LaxmiTaal is the main water body of Jhansi built during 18<sup>th</sup> century, and was the main source of water to the city. It is a rain fed lake to store the rain water. It is a part of historical, cultural and recreational life of Jhansi city. It is located between longitude of 78° 37' E and 25° 27' N of latitude. It is approximately 32.52 hectare in its full spread with an average depth of 2.5 m. But at present it is not maintained due to vast domestic surroundings and waste discharge in it.



**Photo1: Study area (Laxmi taal)**

### Water Sampling

The sampling and physicochemical analysis of water for this study was started in the month of August-September 2021. Samples were collected for two seasons, first in August-September and then in February - March, 2022. This was done to observe the seasonal fluctuations if occurred in water bodies. The samples were collected in plastic bottles. Before sampling bottles are soaked in HCl (dilute) and rinsed with double distilled water. Neck of the bottles were tightly sealed. Then samples were collected from two different sites of LaxmiTaal. Physicochemical parameters like pH, turbidity, alkalinity, Salinity, TDS, DO, COD, BOD and chloride content were measured

### Physicochemical Analysis

**pH:** pH is termed as negative logarithm of the H<sub>2</sub> ion concentration. The pH is determined by digital pH meter which gives direct values of pH.

**Salinity and Turbidity:** These were determined by multi parameter unit.

**Total Alkalinity:** It was determined by titrimetric method using standard solution of 0.01M HCl and methyl orange as indicator.

**Total Hardness:** It was measured using EDTA (Ethylene – Di amine Tetra – Acetic Acid) as titrant with ammonium chloride and ammonium hydroxide buffer solution and Erichrome Black T as indicator.

**Chloride content:** It was determined by Mohr's method using silver nitrate as titrant and potassium chromate solution as indicator.

**Total Dissolved Solids:** This was determined by evaporation method in an oven maintained at 200 °C for 2hrs.

**Dissolved Oxygen and Biochemical Oxygen Demand:** Winkler's method was followed for the analysis of DO and BOD.

**Determination of COD:** The COD (Chemical Oxygen Demand) is closely related to the laboratory standard method named Dichromate method. With this method the chemical oxygen demand is determined during chromic acid digestion of organic loads in waste water.

**Heavy metals:** We applied ICP MS method (mass spectrometer with inductively coupled plasma) for heavy metals detection, which has even lower detection and quantification limits.

### Experimental Setup for Phytoremediation

The phytoremediation process was carried out by aquatic plants. Sample plants were collected from clean water bodies, then washed thoroughly with tap water and distilled water to remove dirt. The acclimatization was done in laboratory conditions with tap water only for 2 days. The aquatic plants such as *Eichhornia crassipes* and *Hydrilla verticillata* were grown for evaluation of pollutant removal potential. Each of these plants were introduced into glass tanks containing 5 L of water for the duplicate water samples separately. The water samples without plant was maintained as a control. The reduction of core parameters such as pH, turbidity, salinity, chloride content, alkalinity, TDS, DO and COD were analysed for treated water [20]. The heavy metals such as Zn, Pb and Fe were analysed for the same.

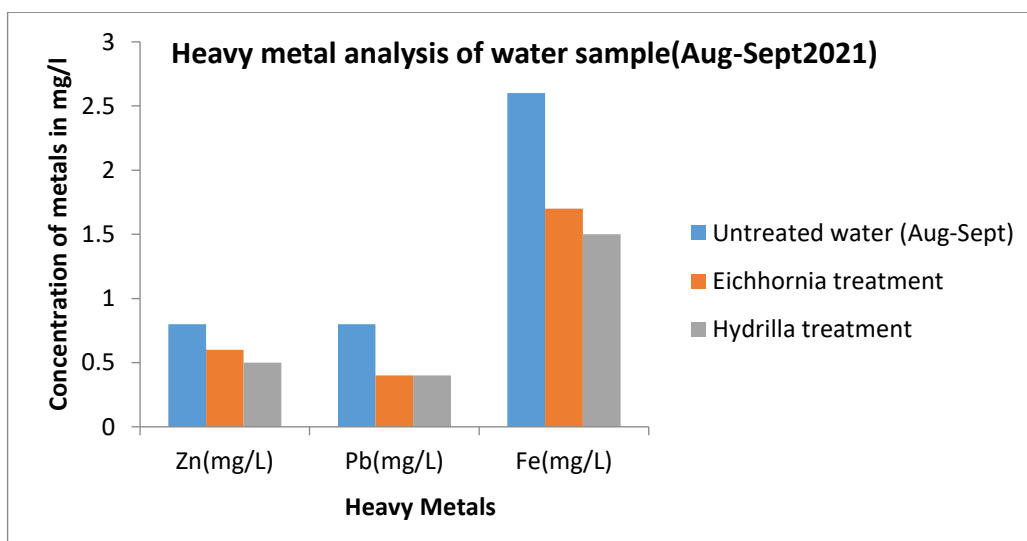
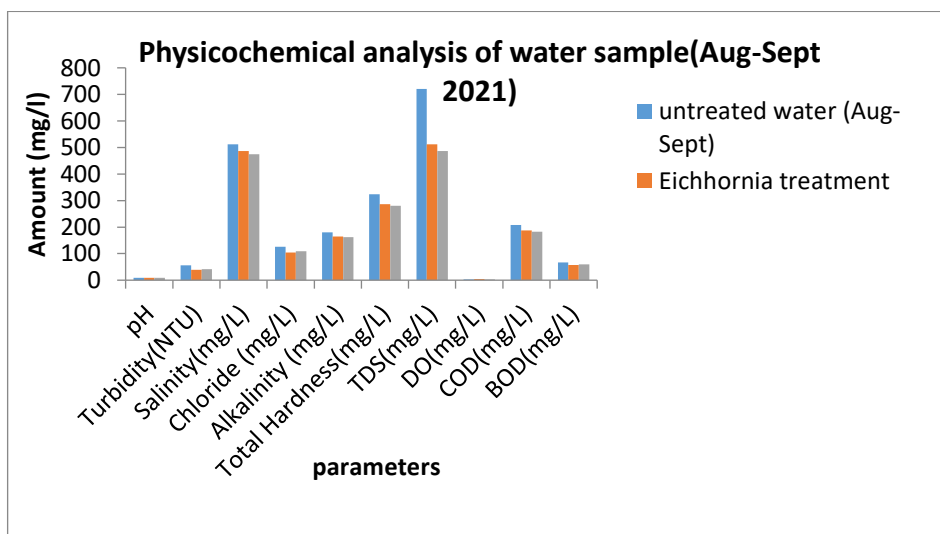
## RESULTS AND DISCUSSION

Physicochemical parameters for the collected water samples were measured and it was found that almost all parameters like turbidity, alkalinity, chloride content, TDS, COD and BOD were above the regulatory level as prescribed by CPCB (Central Pollution Control Board). As mentioned in table 1 and 2, it was observed that turbidity which should be in range of 5-10 NTU, exceeded to 116, which is indication of very high pollution in the water body. Total hardness which should

almost be 200 mg/L, exceeded to 324 mg/L. BOD and COD which are most important parameters to evaluate the quality of water were also detected in very high amount. After treatment with *Eichhornia* and *Hydrilla*, it was observed that almost all the parameters measurements were recorded at decreased amount as turbidity was reduced to 39 NTU from 56 NTU, Salinity was reduced to 474mg/L, chloride was reduced to 104mg/L from 126.4mg/L , COD reduced to 182mg/L, TDS reduced to 486 from 720mg/L. DO was the only parameter which was increased after treatment with both plants.

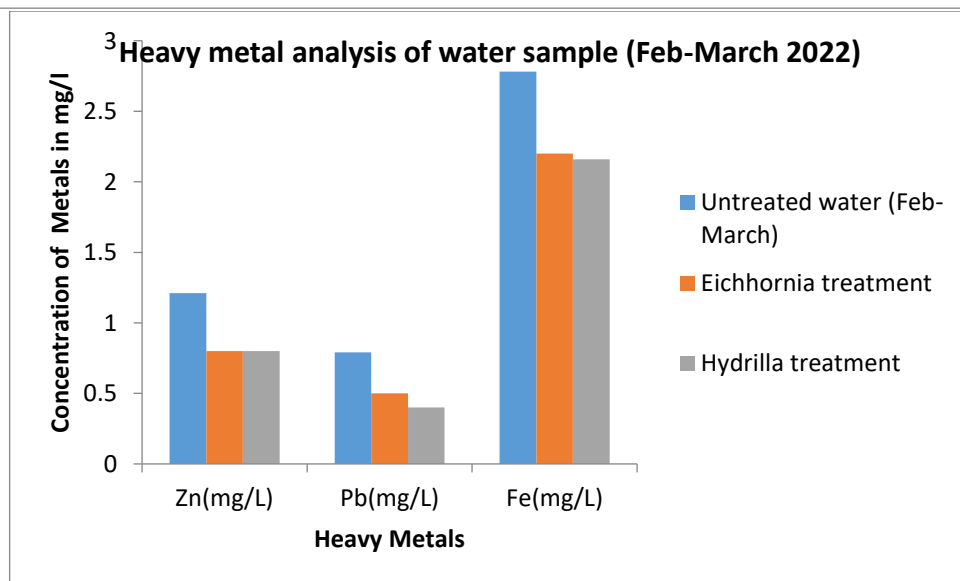
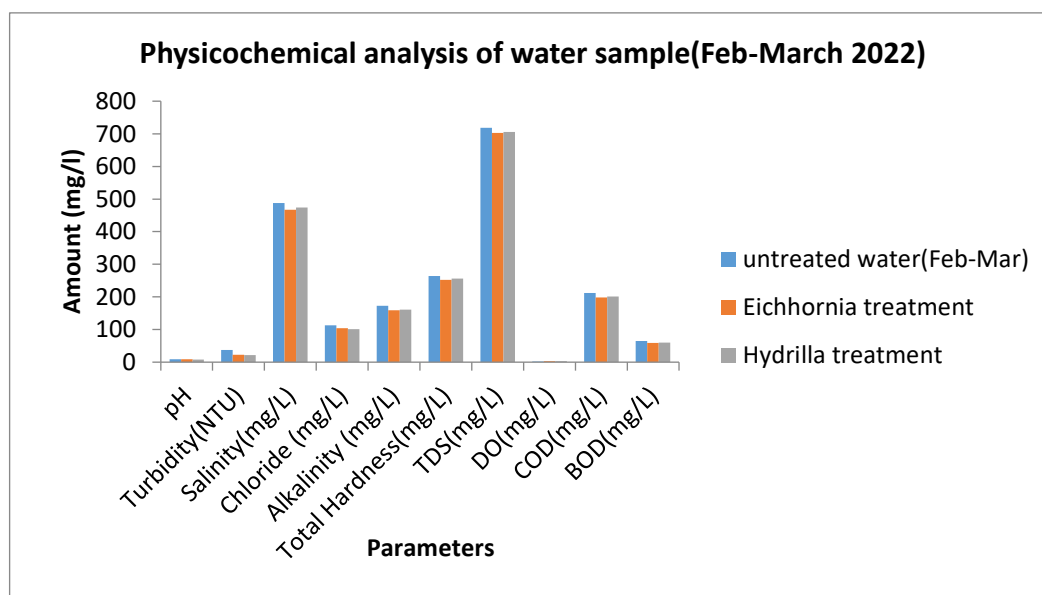
S.No.	Parameters	Untreated water (Aug-Sept)	<i>Eichhornia</i> treatment	<i>Hydrilla</i> treatment
1	pH	9.4	8.6	8.5
2	Turbidity(NTU)	56	39	41
3	Salinity(mg/L)	512	486	474
4	Chloride (mg/L)	126.4	104.6	109
5	Alkalinity (mg/L)	180	164.8	162
6	Total Hardness(mg/L)	324	286.2	280
7	TDS(mg/L)	720	512	486
8	DO(mg/L)	2.92	3.5	3.2
9	COD(mg/L)	208.4	188	182.4
10	BOD(mg/L)	67	57.4	59
11	Heavy Metals			
	Zn(mg/L)	0.80	0.6	0.5
	Pb(mg/L)	0.80	0.4	0.4
	Fe(mg/L)	2.60	1.7	1.5

**Table 1: Data of physicochemical parameters and heavy metals of water samples of LaxmiTaal, Jhansi for normal untreated condition and after treatment with *Eichhornia* and *Hydrilla*. (Aug-Sept 2021).**



S.No.	Parameters	Untreated water (Feb-March)	<i>Eichhornia</i> treatment	<i>Hydrilla</i> treatment
1	pH	9.1	8.6	8.3
2	Turbidity(NTU)	37	23	22
3	Salinity(mg/L)	488	467.6	474
4	Chloride (mg/L)	112.8	104.6	100.8
5	Alkalinity (mg/L)	172.4	158.8	160.6
6	Total Hardness(mg/L)	264	252.6	256
7	TDS(mg/L)	718.2	702.4	706
8	DO(mg/L)	2.1	2.9	3.0
9	COD(mg/L)	212	198.6	200.8
10	BOD(mg/L)	65	59.4	60.0
11	Heavy Metals			
	Zn(mg/L)	1.21	0.8	0.8
	Pb(mg/L)	0.79	0.5	0.4
	Fe(mg/L)	2.78	2.20	2.16

**Table 2: Data of physicochemical parameters and heavy metals of water samples of LaxmiTaal, Jhansi for normal untreated condition and after treatment with *Eichhornia* and *Hydrilla*. (Feb-March 2022)**



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