Biomonitoring Of Metals Contamination In Aquatic Ecosystems By Macrophytes

Swati Gupta, Poonam Mehrotra

Abstract: The study focused on the assessment of metal accumulation in certain aquatic macrophytes to be used as biomonitors. The macrophytes and water samples were collected from January to December 2017 from three selected water bodies – Keerat Sagar, Kalyan Sagar and Madan Sagar of the Mahoba district, central India. Hot digested samples of macrophytes and water were analysed for metal concentration using AAS-200. In the macrophytes and water samples, five metals were investigated: Zn, Pb, Ni, Cu, and Cd. Based on the accumulation levels in the macrophytes, the selected metals were arranged in the order of Zn> Pb> Cd> Ni > Cu>.

Index Terms: Heavy metal, Macrophytes, Biomonitoring, Central India.

1 INTRODUCTION

Occurrences of metal in nature are natural with the earth's crust. Metals are neither generated nor eradicated through any human activity or biological process. There is an increasing concentration of metals in our earth due to the re-allocation of mineral deposits and metals as a result of various industries (including mining and smelting), thermal power plants, combustion of fossil fuel and various industrial activities that might cause a danger to the health of human beings and the ecosystem [1].Anthropogenic emission of high concentrations of heavy metals on earth include both the hydrosphere and the biosphere. As a result of the industrial revolution there is a huge and rising requirement for heavy metals [2].In the present world heavy metal contamination in water is an extremely significant problem. Contamination of toxic heavy metals in water bodies such as ponds, ditches and river water have an effect on the life of local communities that rely on these water bodies for their daily necessities [3]. In the modern era many techniques have been used for the estimation of pollution of water bodies, and biomonitoring is one of them. Biomonitoring is a scientific method designed toevaluate environment revelation of natural and artificial chemicals, based on method sampling and analysis of the tissues of individual organisms. The use of aquatic plants as bioindicators, especially for biomonitoring of aquatic heavy metal pollution, is commonly investigated [4] [5], [6],[7].

2 . MATERIAL AND METHODOLY

2.1 Study Area

Mahoba district which is bounded between latitudes 250o4’36”N to 25o 35’45”N and 79o20’12”E to 80o15,00”E.The northern fringe of the area consists of plain tracts whereas, the central and southern part is hard rock terrain and form a part of Bundelkand Granitoid Complex.

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2.2 Site Selection

Three water bodies of three different region of this district namely Keert Sagar, Madan Sagar and Kalyan Sagar has been chosen meant for present investigation (Fig. 1). Samples for study were collected monthly from three study sites during the time period of January 2017 to December 2017, and each study site have been divided into five different sampling sites.

2.3 Analytical Design

Physico- chemical parameters of water of three study points have been completed according to standard methods (APHA-2012)[8].

2.4 Analysis of Heavy Metals in Water

The samples of water were taken in evaporation dishware and acidified with conc.HNO3. Additional 5 ml conc. HNO3 was added and evaporated to 10 ml. after that it was transferred to a 125ml. conical flask and were added 6ml conc. HNO3 and 2ml HClO4 (70%).Then it was heated gently till white opaque fumes of HClO4 come out .The digested samples were cooled at room temperature, then filtered through Whatman No.42 and lastly the volume was made up to 100ml with double distilled water. The solution was used for the determination of heavy metals. Analysis of heavy metals were done by Atomic Absorption Spectrophotometer (Perkin Elmer).

2.5. Plant Sampling

For bio monitoring of toxic heavy metals contamination in chosen water bodies, some responsive and tolerant macrophytes species were chosen at study sites on basis of richness and abundance. The macrophytes species were chosen Eichhornia crassipes, Hydrilla verticilliata, Ipomoea aquatic , Nymphaea lotus, Lemna spp., Ceratophyllum denersum, Azolla, and Trapa natans used for the heavy metal study of contaminated study areas. Firstly aquatic macrophytes were collected through hand, washed by pond water after that distilled water to eliminate periphyton and sediment particles. The collected plant species were sealed in plastic bags, carefully labeled and brought toward the laboratory.

2.6. Analysis of Heavy metals in Aquatic Plant Species

Analysis of heavy metals were in harvested plant which were systematically washed with distilled water and dried up in an oven at 80oC of duration 48 hr. Dried out plant tissue (1gm) were digested in HNO3(70%) and HCl4(70%) (3:1v/v). Estimation of heavy metals in macrophytes species were done through using Perkin Elmer atomic absorption

spectrophotometer.

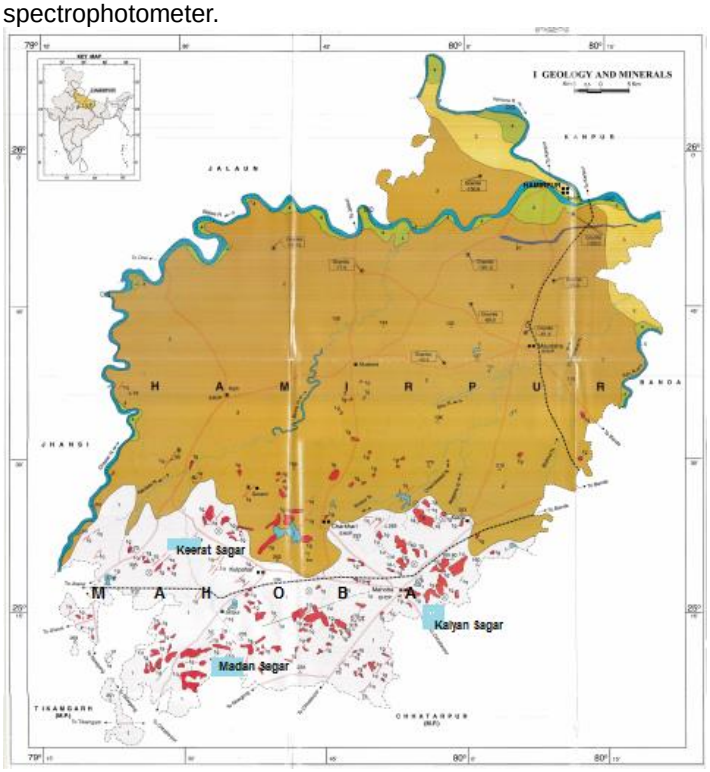

Fig:1- *Map showing the location of the study area.*

3 RESULTS AND DISCUSSIONS

Present investigation following water bodies e.g. Keerat Sagar, Madan Sagar and kalyan Sagar respectively have been selected in Jhansi district of Bundelkhand region. Observations and finding of present work have been tabulated and are as follows.

3.1. Metal concentration in different water bodies

Study data on heavy metal concentration in the water of the respective study areas are presented in Table 1. Among the selected five metals, Zn and Pb were found to be beyond the limit of the Indian standard. Pb presence in water might be known as more injurious for every organism. The average concentration of Pb a in pond was significantly higher (0.728mg/l) in Keerat Sagar, followed by Kaliyan and Madan Sagar. The high concentration of lead in pond water might be accredited to the runoff from roadsides, agricultural land and sewage discharge points. The combustion of fuel from automobiles contains a large lead concentration. In addition, leakage from batteries, radiators of four wheelers and colour paint also have lead content.

Table 1: Average Metals concentrations in water of selected areas

Sl. No.	Metals	Keerat Sagar	Kaliyan Sagar	Madan Sagar	Indian Standard
1.	Cd	0.080 ± 0.010	0.067 ± 0.007	0.048 ± 0.003	.01
2.	Pb	0.728 ± 0.028	0.689 ± 0.003	0.576 ± 0.004	.05
3.	Cu	0.001 ± 0.0005	0.004 ± 0.0007	0.004 ± 0.0003	.05
4.	Ni	0.031 ± 0.019	NA	NA	.02 *
5.	Zn	2.040 ± 0.008	.909 ± 0.003	1.078 ± 0.006	5

Values are Mean ± SE (n = 3); Unit: - concentration in mg/l, NA = not available *WHO Standard

3.2. Macrophyte observation in selected study sites

The accessibility of macrophyte composition in the selected study area and their dissimilarity in abundance in the respective selected water bodies are depicted in Table 2 and summarised as follows: aquatic macrophyte diversity plays significant role in freshwater bodies. Our investigation shows abundance of some macrophyte species in our study area duration of January 2017 to December 2017. A total of eight aquatic macrophyte species were recognised in study points such as Eichhorniacrassipes, Hydrilla verticilliata, Ipomoea aquatic, Nymphaea lotus, Lemna spp., Ceratophyllumdenersum, Azolla andTrapanatans. The Keerat Sagar study area contains all but two of the above macrophytes species. Studies reveal the impact of seasonal variations lying on the expansion of these macrophytes but the abundance of the Eichhornia species was found generally throughout the year ofthe study period. Richness ofIpomea, Hydrilla and Ceratophyllumdemersum species was found in these ponds.

Table 2: Identification of tolerant and sensitive aquatic macrophytes grown in the study areas

Sl. No.	Species name	Keerat Sagar	Kaliyan Sagar	Madan Sagar
1.	*Eichhornia crassipes*	+++	+++	+++
2.	*Hydrilla verticillata*	++	NA	+
3.	*Ipomoea aquatic*	+++	+	+++
4.	*Nymphaea lotus*	+++	++	+
5.	*Lemna spp.*	+	NA	NA
6.	*Ceratophyllum demersum*	++	+++	++
7.	*Azolla*	NA	+++	NA
8.	*Trapa natans*	NA	+++	++

+++ = High, ++ = Medium, + = Low; NA = Not Available

3.3. Metals concentration in plants species (macrophytes) in field condition

The data on concentrations of heavy metal in chosen plant species in field conditions are mentioned in Table 3. Comparison with the average concentrations of heavy metals accumulated by selected plant species in the water bodies are depicted as presented in Figure 2. Our study shows that there are four aquatic macrophytes, i.e. Eichhorinacrassipes, Hydrrillaverticillota, Ipomoea aquatic nd Ceratophyllum demersum that were selected for the study of biomonitoring in the selected study area on the basis of their abundance.

Table 3: average metals concentration in selected aquatic macrophytes grown in study areas

Sl. No	Metals	*Eichhornia crassipes* (Mart.)Solms	*Hydrilla verticillota*	*Ipomoea aquatic*	*Ceratophyllum demersum*
1.	Cd	0.891 ± 0.04	0.230 ± 0.005	0.658 ± 0.008	0.275 ± 0.008
2.	Pb	3.385 ± 0.06	1.530±0.023	2.840±0.002	1.027 ± 0.003
3.	Cu	0.483 ± 0.004	ND	0.093 ± 0.004	0.072 ± 0.006
4.	Ni	0.057 ± 0.008	0.023 ± 0.0003	0.0712± 0.015	0.060 ± 0.09
5.	Zn	13.423 ± 0.009	5.046 ± 0.001	11.502 ± 0.03	4.464 ± 0.004

All values are µg/g

4.CONCLUSIONS

This study concludes that Eichhornia crassipes and Ipomoea aquatic showed significant biomonitor activity for the heavy metals in the freshwater pond systems, and the accumulation is in the order of Zn> Pb> Cd> Ni > Cu>. An elevated trend was noticed among the essential metals and

a decreased trend among the non-essential metals in macrophytes. Samples from Keerat Sagar, with a high degree of metal pollution compared to Kaliyan and Madan Sagar, revealed odds of pollutants from non-point sources too.

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