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Studies on Heavy Metals Removal Observed in Vegetation on Affected River Banks and its Role in River's Self-Purification System.

S. V. Choudhari
Department of Chemistry
K.E.S Anandibai Pradhan Science College, Nagothane, Raigad. Maharashtra

Abstract: *The self-purification mechanism is very important for every river's health. Many factors like organic and inorganic pollutants, local discharges are responsible for river pollution. Scarcity of potable water is global problem. These studies are an attempt to identify pollution causing factors for rivers and to understand her self-purification points. So, sampling of plants, soil, and water was done site wise and season wise for their metal concentrations and biomagnification of metals is observed. Pollutant sources and distance from them is considered. It is observed that Cu and Zn are more accumulated in some plants, making soil and water cleaner, But Ni is less absorbed by plants indicating plants tolerance. plants are tolerant to metals in soil and help in the river's self-purifying system. Thus, vegetation plays important role in river's self-purification along with its geographical characteristics.*

Keywords: Self-purification system, river, vegetation, bioremediation

I. INTRODUCTION

Scarcity of potable water and Pollution has become a global issue. Environmentalists have reported heavy metal accumulation in the atmosphere, the water and the soil. Increased globalization and industrialization have increased the metal pollution due to anthropogenic operations Bioremediation processes involve the bioaccumulation of metals by plants and microorganisms and now adays it has gained importance due to their potential in cleaning and recovering metals. Phytoremediation process with plants at river bank & aquatic plants showed high potential to purify polluted water resources. Plants can purify water by absorption of heavy metals, adsorption, accumulation and degradation of contaminants. So, this research mainly aims to show plant's ability of cleaning water and soil of affected area which further helps in river's self-purification **Literature review-**

Bioremediation with plants is greener method of heavy metals removal. Many plants are reported as hyperaccumulators,such as Alhagi & Mallow plant for Cr and Cd uptake . (Saeed Shojaei et al,2021), *Athyrium esculentum* (AE), *Chromoleana odorata* (CO),*Lantana camara* (LC) for Cd,Cu,Fe,and Pb removal, *Lycopersicon esculentum* (tomato), *Rumex acetosa* (sorrel), and *Solanum melongena* (garden egg for Cd, Cu, Fe, Pb, Mn, and Zn removal (Zakka Israila Yashim, 15 March 2021).Aquatic plants and riverbank side plant adapt the conditions of higher concentrations of heavy metals , become tolerant and are helpful in phytoextraction of heavy metals from water and soil.

Material method

In these studies, long grasses are selected as plant material**.** The water, soil, and plant samples are collected from the river banks at two sites S_1 and S_2 and are preserved properly. After proper identification of plant, plant extract and soil extract were prepared and sent for heavy metal analysis. Heavy metals like Chromium, Copper, Lead. Nickel, Zinc were analyzed using inductively coupled plasma spectroscopy with Mass Spectrometry (ICP -MS) at Saif Powai, Mumbai.

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II. RESULT AND DISCUSSION

In heavy metal concentration analysis, for long grasses, the observed values of heavy metals are given in table-1 &figure-1. To determine Phyto remedial potential, the bioconcentration factor (BCF) of each metal in the selected vegetation is calculated. BCF is the ratio of metal content in plant-to-metal content in soil. Plants *can* be "tolerant," "indicator" and "hyperaccumulator" of these metals and can be used for phytoextraction.

Table1 - Metal concentrations in long grasses vegetation in plant ,Soil & Water in mg/Kg at different sites

	Site -S_1			Site -S_2		
Metals	In-plant	In soil	In-water	In-plant	In soil	In water
Cu (in mg/Kg)	*484.75*	*96.5*	*0.059*	*756.5*	*145.58*	*BDL*
Zn (in mg/kg)	*134.75*	*103*	*0.302*	*133.5*	*82.67*	*BDL*
Ni (in mg/Kg)	*26.25*	*74.05*	*BDL*	*5.75*	*68.52*	*BDL*
Cr (in mg/Kg)	*74.25*	*166.78*	*0.033*	*57.5*	*145.58*	*BDL*

Biomagnifications of the Metals is observed. Higher concentrations of Zn metal are observed in plant i.e. 134.75 mg/Kg and 133.5 mg/kg at sites 1 & site 2 . In soil, observed concentrations are 103 mg/kg and 82.67 mg/Kg. Least values i.e. 0.302 mg/kg and below desired level are observed in water samples at sites 1& 2. Thus, water is purer. This proves that plants accumulate more metals like Cu and Zn, so lesser is remaining in soils. So, these are natural filters of soil also. Very less concentrations in water indicates pureness of water. It is useful phytoremediation process in plants and helps for river self-purification mechanism. But for Ni and Cr metal more amounts are observed in soil and lesser in plants, so these long grass vegetations are tolerant to Ni and Cr metal, as these are accumulated in plants and less are remaining in the soil and water exhibiting biofiltration activity of plants in the region. So, these vegetations are tools for soil decontamination of heavy metals such as Cu, Zn, and Ni .

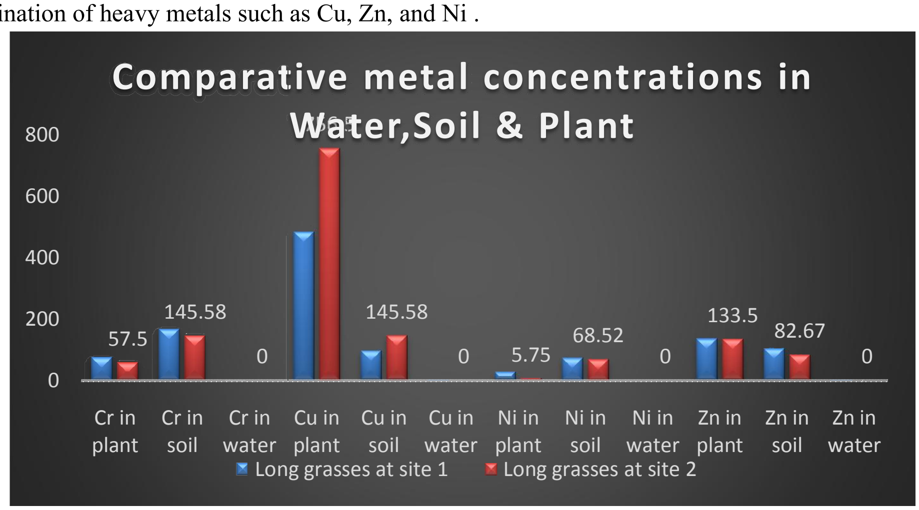

Figure2 - Metal concentrations in long grasses vegetation in Soil & Water in mg/Kg at different sites

According to BCF studies, their BCF values for each metal is calculated for long grasses and are given in table 2 and figure 2 as follows-

plant details	*Cr BCF*	*Cu BCF*	*Ni BCF*	*Zn BCF*
site 1-Long grasses	*0.445*	*5.023*	*0.354*	*1.308*
site2- Long grasses	*0.395*	*5.196*	*0.0812*	*1.614*

Table -2 -Site wise variation of Cr, Cu, Ni, and Zn BCFs in Long grasses vegetation.

The Bioconcentration Factor (BCF) of metals shows the index of metal accumulation ability of plants (Ghosh and Singh, 2005). For Cu and Zn, the BCF values are more than 1, i.e. for Cu- 5.196 .5.023, for Zn 1.308, 1.614 shows it's hyperaccumulator nature. And lesser than 1 value of BCF for Cr (BCF- 0.445 and 0.395) and Ni (BCF 0.354 ,0.0812) proves these plants are tolerant.

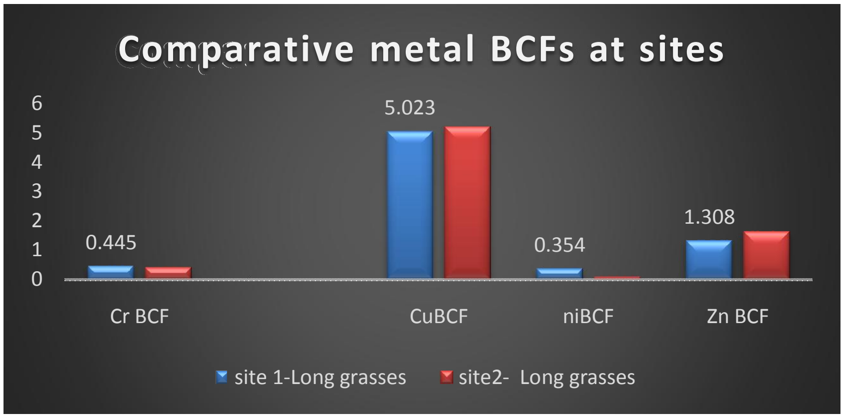

Figure -2 -Site wise variation of Cr, Cu, Ni, and Zn BCFs in Long grasses vegetation.

More metals are accumulated in plants, making soil and water cleaner and help in the river's self-purifying system along with its geographical characteristics

Similar observations like uptake and translocation of Cd, Cu, Fe, and Pb in roadside plant species grown in the semi-urban of Jengka, Pahang, Malaysia is observed (Fazrul Razman Sulaiman, 2018).Similar concentration of Cu- 29.44, Zn-1411, Pb- 87.47, Cd- 13.21mg/Kg concentrations are observed in leaves of woody species on hills near the Beijing Steel Factory (BSF)(Yan-Ju Liu, February 2005) Similar observations are observed with bioconcentration factor of Cu > 1 in the roots, stems, and leaves of Avicennia trees and Zn> 1 in the roots of Rhizophora trees at (Novertia Dian Takrina ,2017).

Though self-purification is natural process, these natural phenomena like bioremediation, geographical characteristics of river are helpful in water purification. Even phytoremediation process can be applied along river bank by planting the hyper accumulator plants bankside. But irrespective of manmade efforts, Nature's great ability is observed through phenomena like river's self-purification. But further studies are required in this research area .

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