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ANALYSIS OF SOIL DATA IN SAND MINING AREA OF CHITRAKOOT (U.P.) & EFFECT OF SAND MINING ON HERB BHRINGARAJA (*ECLIPTA ALBA*) WITH SPECIAL REFERENCE TO HEAVY METAL CONCENTRATIONS

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ABSTRACT

The sand mining has several impacts on the river environment. Sand mining disturbs and completely remove the habitat from the mined zones. It leads to changes in its channel form, physical habitats and food webs – the river's ecosystem. It also increases the velocity of flow in river which destroy flow-regime eventually erodes the river banks. Sand mining and exposure to toxic material through riverrine is an increasingly serious problem the world over. The unscientific use of hazardous materials in mining industries and its dumping has created a great risk for human life, plants and animals. In This Study, Plant *Eclipta alba* and soil samples were analyzed to determine the heavy metals (Lead, Cadmium & Arsenic) Three Samples of Plant *Bhringaraja (Eclipta alba)* and Soil were collected from the Karwi District of Chitrakoot (U.P.) & Rajapur (U.P.) (i.e. near the riverline and less polluted area) and the one sample of Plant and soil from natural Habitat with very minimum pollution forest area across Chitrakoot region. The extent of soil contamination by heavy metals and the potentials of herbaceous plant species to remediate the soils at a selected mining site were assessed. Physico Chemical studies were carried out as per Standard Protocol and heavy metals were analyzed using SOP.

KEYWORDS: Bhringaraja, Lead, Cadmium, Arsenic, Sand Mining, Heavy metal.

INTRODUCTION

Environmental imbalance and exposure to toxic material to river bodies through sand mining is an increasingly serious problem the world over. Similarly the heavy metals are assimilated in the environment from vehicle exhaust, from the smoke of industries or the spreading of industrial effluents through water (Natraj et al 2019). The use of herbal medicines has been on the rise in recent years. Heavy metal accumulation in plant by sand mining has multiple direct and indirect effects on plant (*Eclipta alba*) growth and can alter many physiological functions by forming complexes with O, N andS ligands (Khan et al 2013). They also interfere with membrane functioning, water relations, protein metabolism and seed germination (Black et al 1969). However, if mining activities are not properly organized, it can result to various environmental problems. The industry's operations ranging from prospecting to excavation are seen to be causing several environmental problems ranging from erosion, pollution, formation of sinkholes, soil nutrients loss, bio-diversity loss, heavy metaland organic contamination of groundwater and surface water (Khan et al 2008). Soil Nutrients play a vital role in enhancing the growth of forest because plants require essential soil nutrients such as nitrogen, calcium, potassium, phosphorus, among others which are assimilated from the soil to complete their vegetative and reproductive life circles (Benedire et al 2020). Other essential elements such as carbon, hydrogen and oxygen are readily available to plants because they are freely obtained from carbon dioxide and water and converted to carbohydrates during photosynthesis. Irrespective of the socio-economic importance of mineral resources (Baker et al 1989). Mining is one of the main sources of heavy metal environ-mental pollution worldwide. Indeed, intensive extraction of valuable minerals releases large quantities of volatile elements and toxic dust particles into the environment, contributing to serious pollution of aquatic and terrestrial ecosystems There are three stages of mineral development (i.e exploration, mining and processing), have caused different types of environmental damages, which include ecological disturbance, destruction of natural flora and fauna, soil nutrient loss, land degradation and water, among others (Johnson et al 1998). The World Health Organization (WHO) recommends that medicinal plants which form the raw materials for the finished products may be checked for the presence of heavy metals, pesticides, bacterial or fungal contamination. The environmental impact of heavy metals such as Cd, Pb, Hg and As, as well as their health effects, has been a source of major concern (Vijver et al 2001).

MATERIALS AND METHODS

Sample Collection -

Three samples of the Bhringaraja were collected from sand mining areas of Chitrakoot District Uttar Pradesh & Rajapur U.P, and one sample is collected from Natural habitat Forest area of Chitrakoot region. All the four samples of Bhringaraja (*Eclipta alba*) are been authenticated by the experts and dried under shade. Powdered and subjected for Physico Chemical Studies as per Standard Protocol. All the samples were analyzed for heavy metal concentration by the Perkin Elmer AAS, under the standard conditions of measurement. Samples were tested for Concentration of Cadmium, Lead and Arsenic. The soil from where the samples are collected are been subjected for qualitative and quantitative analysis of possible heavy metal concentration (Unanaonwi et al 2017).

(Collected plant samples)

Method of Data Collection

Soil and Vegetation composition Sampling procedure and Data Collection

To assesses vegetation composition, two areas were purposely selected:- vegetation within the cement factory and vegetation within the adjacent site 5km away. Plot of size 100m x 100m (1 hectare) were demarcated. This was further demarcated to sub-plots size of 20m x 20m from which 5 sample plots were randomly selected for the study. Tree species found within sample plots were recorded under the following parameters:- diameter at base (db), diameter at breast height (dbh), and total height. For soil analysis, 6 plots of size measuring 10m x 10m were laid within the cement factory and the adjacent forest to collect soil samples. Four auger points per site were drilled at random to a depth of 0-45cm, using soil auger in four directions on a transect line, for site 1, site 2, site 3, site 4, for both the soil within and outside the factory. The soil samples from the four auger points per location were poured together and mixed thoroughly in a polythene bag. An appreciable quantity was poured into a polythene bag, labeled and taken to the laboratory for analysis (Rahimi et al 1998) (Bose et al 2002).

Analysis

Data Analysis for Vegetation Cover

Analysis for Vegetation Cover

Floristic compositions in the two sites were estimated using diversity indices such as species richness, diversity and evenness. Species richness was computed using Margalef (1951) as cited by Spellerberg (1991) and Magurran (2004).It is measured by the formula:

$$D = \frac{(S-1)}{\ln N}$$

Where, **D** = specie▪s richness index (Margalef index), **S** =number of species and **N** = the total number of individuals.

Species diversity was estimated using Shannon- wiener diversity index as cited by Spellerberg (1991); Turyahabwe and Tweheyo (2010); Ruszazyk *et al*;(1992) cited by Radha *et* al; (2016).

Shannon- wiener diversity index equation is stated as:

$$H' = -\sum_{i=1}^{s} p_i \ln p_i$$

Where H' = species diversity index, **pi** = the proportion of individuals or the abundance of the ith species expressed as a proportion of the total abundance. The use of natural logs is usual because this gives information in binary digits.

Species evenness was estimated using Pielou's evenness (equitability) index (Pielou, 1975) cited by Turyahabwe and Tweheyo (2010) as followed:

$$J' = \frac{H'(observed)}{H\max}$$

J' = Pielou'▪s evenness index. Where **H'** (observed) / **Hmax**, where **Hmax** is the maximum possible diversity, which would be achieved if all species were equally abundant(=**Log S**)

The indices were computed for all plant species in various growth forms (trees, sapling, shrubs and herbs) in each plot of vegetation location.

Data analysis for soil sample

Soil P^{H} was determined using pH Meter, Available phosphorus was determined using the method of Liu. (Liu, 2000). Potassium determined using Flame photometry and organic carbon determined using wet oxidation Method (Black and Walkley, 1934). Paired test was used to analyzed soil variables such as Soil PH , soil organic carbon and organic matter, soil Nitrogen, soil Phosphorus and Potassium. The level of significance in each case was set at

P<0.05(Newman et al 2009).

RESULT AND DISCUSSION –

PHYSICO-CHEMICALANALYSIS:

TableNo.1: Physico chemical studies of Plant samples

Sl.No	Plant Samples	Alcohol Soluble Extractive	API Standards	Water Soluble Extractive	API Standards	Ash Value	API Standards of Ash Value
1	A	10%	Not less than 5%	24%	Not less than 15%	19%	Not more than 22%
2	B	12.4%		15.8%		19.5%	
3	C	13.6%		19.6%		15.5%	
4	D	10.8%		18.4%		22.5%	

ESTIMATION OF HEAVY METAL CONCENTRATIONS IN PLANT AND SOIL SAMPLES:

TableNo.2: Concentration of Lead, cadmium and Arsenic in Plant Sample

	Heavy Metals	Concentration
	Lead	0.001 mg/kg
PlantSampleA	Arsenic	0.001 mg/kg
	Cadmium	0.0003 mg/kg
PlantSampleB	Lead	0.01 mg/kg
	Arsenic	0.01 mg/kg
	Cadmium	0.003 mg/kg
PlantSampleC	Lead	0.01 mg/kg
	Arsenic	0.01 mg/kg
	Cadmium	0.003 mg/kg
PlantSampleD	Lead	0.01 mg/kg
	Arsenic	0.01 mg/kg
	Cadmium	7.277 mg/kg

TableNo.3: Concentration of Lead, cadmium and Arsenic in Soil Samples

	HeavyMetals	Concentration
Soil Sample A	Lead	58 mg/kg
	Arsenic	<0.05mg/kg
	Cadmium	<0.05mg/kg
Soil SampleB	Lead	<0.05mg/kg
	Arsenic	<0.05mg/kg
	Cadmium	<0.05mg/kg
Soil Sample C	Lead	<0.05mg/kg
	Arsenic	<0.05mg/kg
	Cadmium	<0.05mg/kg
Soil Sample D	Lead	58.72 mg/kg
	Arsenic	<0.05mg/kg
	Cadmium	4.12 mg/kg

DISCUSSION -

Soil may become contaminated by the accumulation of heavy metals and metalloids through emissions from the rapidly expanding industrial areas, mine tailings, disposal of high metal wastes, leaded gasoline and paints, land application of fertilizers, animal manures, sewage sludge, pesticides, waste water irrigation, coal combustion residues, spillage of petrochemicals, atmospheric deposition.13,14 Heavy metals constitute an ill -defined group of inorganic chemical hazards, and those most commonly found at contaminated sites are lead (Pb), arsenic(As) & cadmium (Cd).15 The adequate protection and restoration of soil ecosystems contaminated by heavy metals require their characterization and remediation. Combining plants and microbes for the remediation of heavy metal polluted soils. Using plants for remediation of heavy metal polluted soils. Phyto remediationisan aspect of bioremediation that uses plants for the treatment of polluted soils. Phyto extraction is the most common form of phytoremediation. It involves accumulation of heavy metals in the root and shoots of Phyto remediation plants. These plants are later harvested and incinerated. It is evident that there is an urgent need to implement a regular monitoring and testing program on the quality of the local and imported herbs sold in the market. Further studies are required to determine the presence of toxic metals and to assess their long-term cumulative risk on consumer health. Atomic absorption spectrometry (AAS) is the most widely used techniques for heavy metals quantitative analysis in environmental samples. In AAS Atomic absorption is so sensitive that it can measure down to parts per billion of a gram (μg dm^{-3}) in a sample. The technique makes use of the wavelengths of light specifically absorbed by an element18

Lead:

The FAO/WHO maximum permissible limit of lead in consumed medicinal herbs is $10 mg·kg^{-1}$. Lead is known to be one of the highly toxic environmental pollutants. It can complex with various biomolecules and adversely affect their functions. Lead exposure may have an adverse effect on the blood, nervous, immune, renal, skeletal, muscular, reproductive, and cardiovascular systems causing poor muscle coordination, gastrointestinal symptoms, brain and kidneys damage, hearing and vision impairments, and reproductive defects. Exposures to lead at early childhood and prenatally are associated with slowed cognitive development, learning deficits, and many other effects Though the presence of Lead was more than permissible limits in the soil sample collected from industrial area, Concentration of Lead was below detection limits in Plant sample collect from the same place, this may be due to Poor absorbability of Lead or less affinity of Bhringaraja Plant towards Lead compounds.

Cadmium:
The FAO/WHO maximum permissible limit of cadmium exceeding 0.3mg·kg−1. Cadmium is emitted to air by mines, metal smelters and industries using cadmium compounds for alloys, batteries, pigments and in plastics. Organic cadmium compounds are very unstable. In contrast to lead and mercury ions, cadmium ions are readily absorbed by plants. They are equally distributed over the plant. Cadmium is taken up through the roots of plants to edible leaves, fruits and seeds. During the growth of grains such as wheat and rice, cadmium taken from the soil is concentrated in the core of the kernel. Cadmium also accumulates in animal milk and fatty tissues. Therefore, people are exposed to cadmium when consuming plant- and animal-based foods. Cadmium accumulates in the human body affecting negatively several organs: liver, kidney, lung, bones, placenta, brain and the central nervous system. Other damages that have been observed include reproductive, and development toxicity, hepatic, hemato logical and immunological effects.

Arsenic:
The FAO/WHO maximum permissible limit for inorganic arsenic as 0.015 mg/kg body weight & Organo-arsenic in takes of about 0.05 mg/kg body weight/day seemed not to be associated to hazardous effects.26Arsenic is a metalloid. It is rarely found as a free element in the natural environment, but more commonly as a component of sulphur-containing ores in which it occurs as metal arsenide's. Arsenic is quite widely distributed in natural waters and is often associated with geological sources, but in some locations anthropogenic inputs, such as the use of arsenical insecticides and the combustion of fossil fuels, can be extremely important additional sources. Arsenic occurs in natural waters in oxidation states III and V, in the form of arsenous acid (H3AsO3) and its salts, and arsenic acid (H3AsO5) and its salts, respectively.27Chronic arsenic ingestion from drinking water has been found to cause carcinogenic and non carcinogenic health effects in humans.28 Most of ingested arsenic is rapidly excreted via the kidney within a few days. However, high levels of arsenic are retained for longer periods of time in the bone, skin, hair, and nails of exposed humans. The adverse effects of arsenic in groundwater used for irrigation water on crops and aquatic ecosystems are also of major concern. The fate of arsenic in agricultural soils is less characterized compared to groundwater. However, the accumulation of arsenic in rice field soils and its introduction into the food chain through uptake by the rice plant is of major concern mainly.

CONCLUSION:
Present Study reveals the Presence of Cadmium & Lead in Higher Concentration in samples collected around Fields near Sand mining Area, which can be related to Environmental Pollution due to Dumping of hazardous Industrial waste. This research gives a overview on how it can destroy riverine vegetation, cause erosion, pollute water sources and reduce the diversity of animals. The beach and dune system habitat along the coastal zones also victims. Off-shore sand mining pumping biota with sand and damaging coastal ecosystem & also herbal herb (Eclipta alba) damage caused by sand mining across Mandakini Bank of Chitrakoot U.P, Research also stated that sand sustains the rivers and the percolation of water to far off distances both for the growth of trees to sustain drinking water and raise cultivation. It is almost a lifeline to the human existence. Without considering the precise gift provided by nature, commercial

exploitation for short term gains by pumping out the sand indiscriminately from the rivers, dunes and beaches will destroy whole environment. It appears that the areas surrounded by the mines, and more particularly soils and surface waters, were seriously polluted by heavy metals released by extraction in water bodies & these heavy metals can severe damage valuable herb grown in there surroundings.

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