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Analysis of heavy metals concentration in soil around the Tapti river

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ABSTRACT

Metals, a major category of globally distributed pollutants are natural elements that has been extracted from the earth and hardnessed for human use. Metals are notable for their wide environmental dispersion from various activities, their tendency to accumulate in select tissues of the human body and their overall potential to be toxic even at relatively minor levels of exposure. Soil nearby water contain high amount of heavy metals such as, Pb,Cd,Zn,Cu,Ni,Hg,Cr and Fe purpose also, agriculture waste over use of fertilizer and pesticides also openly dumping of because of non point contamination sources. Most commonly river water is used for irrigation hazardous waste materials from cities, village also from vehicle exhausts. In developing countries all the activities take place on the river bank. So the river becomes sink of heavy metal disposal such contaminated water is used for irrigation purpose then level of toxic metal increases and had adverse effects on soil, plant, health. The study is aimed to analyse and access the existence of heavy metal in the surface soil near Tapti river using ICP-AES.

Keywords: Soil, Heavy metals, ICP-AES, Pollution, Contamination.

Introduction:

Good soil and a congenital climate for productivity are valuable asset for any nation but due to human activities soil becomes the sink store for many pollutants (1). Heavy metal pollution of soil is one of the most important environmental problems though out the

world. In fact heavy metals have significant toxicity for humans, animals, microorganism and plants. All trace elements are toxic to living organism at excessive concentration but some are essential for normal healthy growth and reproduction by plant and animals at low but critical concentration . Deficiency in these essential elements of micronutrients can lead to deceases and even death of plant and animal. The essential trace includes Co,Cr,Cu,Mn,Mo,Ni,Sc and Zn while Ag,As,Ba,Cd,Sg,Pb,Sb, and Th are known to have essential functions but cause toxicity above certain tolerance level. The most important heavy metals with regard to potential hazards and the occurrence in contaminated soil are As,Cd,Cr,Sg,Pb, and Zn (2) The concentration of these toxic elements in soil may be derived from various sources, anthropogenic pollution weathering of natural high background rocks and metal deposits (3).

Heavy metal contamination of soil can occure as a result of anthropogenic activities such as industrial influents and domestic waste water drain into river water agricultural as well as natural activities (4-7). Rural activates and increasing air pollution are the most important sources of heavy metals in the soil, heavy metals get accumulated over time in soil and plant and a negative influence on physiological activates of plant effecting the reduction in plant growth, dry matter accumulation and yield. Some of the heavy metals (Pb,Cd,Sg) even in trace concentration are toxic to plants and animals (8). Heavy metal pollution of soil enhances plant uptake causing accumilation in plant tissues and eventual phytotoxicity effect and can change plant communities (9). Expose to lead in the soil can be harmful to humans, the health effects includes increase blood pressure, headache, memory and concentration problems, fertility problems in men miscarriage in woman, who are exposed during pregnancy and damage the nervous system in children,(10), the aim of this study was to access the heavy metals concentration in soil around the Tapti river.

Methodology:

Soil samples were collected at four different locations around Tapti river area. In each location representative composite samples obtained where air dried and pulverized using porcelain mortar and pestle. The grain obtained was sieved using 6 mm sieve size mesh and the sieved grain obtained were stored in cleaned labelled polythene bags for

further treatment a total 1 g of each sample was digested in Teflon beaker with 10 ml concentrated HNO_3 and was boiled until the solution was almost dry 5 ml $HClO_4$ was added further and the boiling continued until the solution was almost dry 5ml HF was lastly added until the solution dried while heating the residue obtained after the boiling was, dissolved in 1 ml concentrated HNO_3 10ml of distilled water was added to dissolved residue of the digested sample and heated to boiling the solution was cooled and filtered. The filtrate obtained was put in 25 ml standard flask and was made up to the mark with distilled water. The analyses (Fe,Cu,Zn,Cr,Pb,Cd,Ni and As) contained in each of the filtrate were determining using ICP – AES technique.

Table-1 : Heavy metal concentration in selected sampling station.

Sampling station	Cu (ppm)	Zn (ppm)	Fe (ppm)	Ni (ppm)	Pb (ppm)	Cd (ppm)	As (ppm)	Hg (ppm)
S1	0.328	25.58	293.6	0.283	ND	ND	ND	ND
S2	0.392	33.25	298.7	0.301	ND	ND	ND	ND
S3	0.415	38.6	329.7	0.238	ND	ND	ND	ND
S4	0.409	78.63	282.5	0.173	ND	ND	ND	ND
Maximum Permissible Limit	50 ppm	300 ppm	-	50 ppm	100 ppm	0.3 ppm	20 ppm	10 ppm

*ND-not detected

Result and discussion:

Copper is a trace element in most soil, it is an essential element for plants, animals. But it is also has a toxic elements which has been major concern to an organism. Highest copper concentration 0.411 ppm wad recorded at S2 place. The copper content in konya close basin is around 0.5-4.0 ppm [11] but it is much higher than present study of soil, copper in soil content differs according to the soil type and pollution sources. Some studies have shown different values for copper content in soil:, 1.40-3.76 ppm in. [12] 6.0-7.30 ppm in (13) and 20-118 ppm in (14)0.526 to 4.274 ppm of copper in soil of green area (15), soil around chinneaeru river 7.7 to 96.6 mg kg-1 was recorded (16), average concentration 49.24 mg kg -1 of copper in soil around subin River (17).

Zinc is a trace element in most soil especially in acid soil, it is an essential nutrient for all organism. The soil data of present study show the soil was not polluted. In present

study concentration of zinc in soil ranges from 24.575 to 79.629 ppm with an average mean 42.763 ppm. Highest level 52.97 and 94.86 mg kg-1 zinc in a waste water irrigated soil of konya turkey (18). 1.86 and 10.02 mg kg-1 zinc was recorded in sewage water irrigated soil in Delhi. India (19). Zinc in road side soil varies from 25.0-70.0 mgkg-1 from motor vehicles activities (20), soil near open land lead battery dump site 17.7 to 37.8 ppm of zinc was recorded (21). The pollution of zinc in arable land was mainly from the fertilizer especially from manure . The contribution of zinc from atmospheric deposition in minor (22). The clearest effect of zinc excess is reduction of root growth for the low tolerant plant (23).

Iron is common and rich element in soil and is essential nutrient for all organisms. No literature has suggested a toxic level of this element. In present study Iron in soil ranges from 282.50 to 328.66 ppm there is no guideline value of Iron in soil so, study area soil is not polluted when compared with maximum allowable concentration in soil high concentration of Iron due to forming activity or natural existence. Iron in konya turkey soil ranges from 655-16234 µgg-1 was much higher (15) 30.30 to 74.83 to 74.89 gkg-1 soil of industrial area of Thane Region Maharashtra (24). Soil around metal scrap dumps of abraka city. Average concentration was 14.31 mg kg-1 (25). 235.0 to 12965.0 µgg-1 Iron in soil of hosur road Banglore (26)

Studies indifferent countries show Nickel contents in soil on a wide scale from .2 to 450 ppm Nickel toxicity is generally seen in soil irrigated with waste water. The concentration of Nickel in soil ranges from 0.172 to 0.287 ppm all the sampling station result show below the limit. 0.1 ppm , Nickel in soil around open lead battery dump site (21). (15) recorded highest 2.812 ppm (26) Recorded 20.45 – 663.50 µgg-1 Nickel in soil of hosur road Bangalore, soil of Agbore city average value of Nickel was 4.48 mg kg-1 and in Abrica city average Nickel in soil was 5.10 mg kg-1 reported (25).

Lead is not detected in soil of Tapi river basin the sources of lead in soil was use of artificial fertilizer and pesticides cause an increase of lead level. High concentration of lead in soil due to the industrial effluent and domestic waste water is released in open land also air pollution resulting from vehicle exhaust output and in cineration of fossil fuel into the environment highest average 11-52 mg kg-1 lead was recorded in Agbor vicinities

(25) also 623.95 µgg-1 recorded in Jan-March 2007 of Hosur road Bangalore(26) soil sample of irrigated by polluted water lead varies from 7.95- 23.2 ppm of E1- Khashab cannel cairo-Egupt.(27) Lowest 0.439 ppm lead was recorded in grass soil (15).

Cadmium is a trace element in most soil it is not a essential nutrient of plant but a toxic element to plant, animal and human beings. The accumulation of cadmium in soil can be from Phosphate and compound fertilizer was the first contributor (22). Also use of waste mud may introduced cadmium into the soil (11, 28) if salinity of in soil increasing accumulation of cadmium in plant also increase (29) the acceptable level of cadmium in agriculture is around 3 ppm and generally was lower than 0.1 in soil (30,31) lowest cadmium in range of 0.001 -0.005 ppm soil in garden area of konya turkey (15) highest average value 4.05 mg kg-1 in soil around subin river in Kumasighana (17). Arsenic and mercury was also not detected in soil of study area lowest arsenic was found in thane region of soil in range of 0.073 – 6.86 mg kg-1 (24) low range of 0.1 to 0.2 ppm was recorded in open land metal dump site area (21) 1.11- 1.54 mg kg-1 mercury was detected in soil (24) and below the guideline value mercury in soil recorded (20)

Conclusion:

This study hereby concludes that the soil near Tapti river has been not contaminated when compare with MAC. This therefore has made the study are safe for human and agricultural activities.

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