International Journal of Theoretical & Applied Sciences, Special Issue-NCRTAST 8(1): 38-40(2016)

ISSN No. (Print): 0975-1718
ISSN No. (Online): 2249-3247

Characterization of Heavy Metals in Contaminated Agricultural Soil

Rashmi Ahuja
Professor, Department of Chemistry,
Govt. S.V. College Berasia, Bhopal, (Madhya Pradesh), INDIA

(Corresponding author: Rashmi Ahuja)
(Received 11 April, 2016 Accepted 20 May, 2016)
(Published by Research Trend, Website: www.researchtrend.net)

ABSTRACT: The study analyzed the heavy metals in soil at various points along Canal at Laharpur Dam, which is popular for vegetable cultivation. Despite the serious environmental and public health effects, one of the associated risks is contamination of crops by heavy goodness of urban agriculture as a source of income and supplement of food supply, the practice is associated with metals and other toxic chemicals. As trace elements some heavy metals viz. Cu, Se and Zn are essential to maintain the metabolism of human body. However at higher concentrations they can lead to poisoning. Soil analysis indicated that the concentrations of heavy metals are highest at top soils and decreased with depth. Based on field observation, laboratory characterization and correlation six different soils were identified and interpreted as per their phases. A total of 60 soil samples were analyzed for major heavy metals like Cd, Co, Cr, Cu, Fe, Hg, Ni, Mn, As, Pb and Zn by using microwave assisted aid digestion and inductively coupled ICP-AAS. Results revealed that surface soils had mean Cu, Cd, As and Zn concentration that were over two times higher than the background values with Cu, Cd and Zn clearly contributed by anthropogenic sources. The multivariate analysis showed that Mn, Co, Ni, Fe, Cr in the surface soils were primarily derived from lithogenic sources, where as Hg and As contents were controlled by both natural and anthropogenic sources. Soil pollution by Pb was more widespread than the other heavy metals, was contributed by latter source.

Key words: Trace metal, vegetable cultivation, anthropogenic, lithopogenic

I. INTRODUCTION

Soil is most vital and non-renewable natural resource whose use greatly determines the capability of life support system and the socio-economic development of any country. Soil pollution by heavy metals is a significant environmental problem worldwide. These heavy metals may adversely effects soil ecology, agricultural production and ground water quality and will ultimately harm the health of living organisms through food chain. The effects are closely related to the biological availability of heavy metals, which in turn are controlled by the metal ion speciation in the soil. Thus, the determination of free metal ion concentration in soil solution becomes important, which not only depends on the total metal content in soils, but also on the metal species that exist in the soil. Accumulation of heavy metals in crop plants is of great concern due to probability of food contamination through the soil root interface. Though the heavy metals viz. Cd, Pb and Ni are not essential for plant growth they are readily taken up and accumulated by plants in toxic form. Ingestion of vegetables irrigated with waste water and grown in soil contaminated with heavy metals posses a possible risk to human health. Most of the studies show that use of waste water contaminated with heavy metals for irrigation over long period of time increases the heavy metal contents of soil above the permissible limit. Ultimately increasing the heavy metal content in soil also increases the uptake of heavy metals by plants depending upon the soil type, plant growth stages and plant species. For investigating all these, this study was done, to ultimate the environmental protection agencies, industrialists and to highlight the concerning authorities to take immediate precautionary steps for the betterment of environment and human life as well. Agricultural soils are also significantly influenced by Cd, Hg and Pb derived by anthropogenic activities. Generally, the contamination levels of Cu, Pb, Zn and Cd are higher than those of Ni and Cr.

II. EXPERIMENTAL

Samples were randomly mainly collected from the selected areas of the location near the water reservoir. At least ten samples from each site were collected to a depth of 10-20 cm. Several soil samples were taken and thoroughly mixed to obtain a bulk sample for each sampling site. Samples were dried and sieved through less than 2mm sieve.

The sieved soil samples were digested with mixed acids HF, $HClO_4$, HNO_3, Aquaregia, H_2SO_4 and boric acid. Finally the total concentrations of As, Hg, Cd, Cr, Cu, Ni, Pb and Zn were determined by ICP-AAS. These sample processing methods and analytical tools are acceptable.

III. RESULTS AND DISSCUSIONS

Status of soil pollution by heavy metals summarize in table. The mean concentration of Cu, Co, Cr, Fe, Hg, Mn, Ni and Pb in the soil samples were found as follows:

Heavy Metal	As	Cd	Cr	Cu	Fe	Hg	Ni	Pb	Zn	Mn
Concentration (mg/kg)	79	380	290	4400	0.07	371	86	450	7100	372

Clear accumulation of Cd, Cu, Zn and As were observed through the investigation of all soil samples from agricultural land. Approximately 20% of soil samples were moderately to heavily polluted by Cu, Cd, Zn and As. These findings have more important implication for the development of pollution prevention and reducing strategies to reduce heavy metal pollution for regions undergoing fast industrialization and urbanization.

The most common heavy metal found at sites in order of abundance are Pb, Cu, As, Zn, Cd, Cr and Hg. Those metals are important since they are capable of decreasing crop production due to risk of bio-accumulation and bio-magnification in the food chain. Knowledge of basic chemistry, environmental and associated health effects of these heavy metals is necessary in understanding there speciation and bio-availability.

Heavy metals also occur naturally but rarely at toxic levels. Potentially contaminated soils may occur at old landfill sites, fields that had past application waste water. In general, Cr and Ni appear to be the least contaminated elements in all sites, while Cu, Pb, Zn show the highest values. The concentrations of Cd, Cu, Pb, Zn, Cr, Ni, As, Hg indicate that the amount of heavy metals is widespread in environment. The sources of Cd, Hg and As in agricultural soils maybe mainly originated from pesticides and fertilizers. Based on the metal concentration, nearly all the concentrations of determined metals on agriculture soils are higher than background values.

IV. CONCLUSION AND RECOMMENDATIONS

Soil is a crucial component of rural and urban environments and in both places land management is the key to soil quality. The main goal of this research work was to assess the concentration of some toxic heavy metals in the soil irrigated with contaminated water. These results indicate the significant need for the development of pollution prevention and reduction strategies to reduce heavy metal pollution for regions undergoing fast urbanization.

The study concludes that contamination of Cd, Pb and Ni in edible portion of vegetables causing potential health risks in the long term. The study also points to the fact that adherence to standards for heavy metal contamination of soil does not ensure safe food. Attention must be paid to improve water quality of dam which should also consider heavy metals so that soil is exposed to minimum amount of heavy metals. Prevention is the best method to protect the environment from contamination by heavy metals. Soil crop management methods can help prevent uptake of pollutants by plants, leaving them in the soil. The soil becomes the sink, breaking the soil-plant-animal/human cycle through which the toxin exerts its toxic effects. A few management practices will not remove the heavy metal contaminants but will help to immobilize them in the soil and reduce the potential for adverse effects from the metals.

The following management practices will not remove the heavy metal contaminants, but will help to immobilize them in the soil and reduce the potential for adverse effects from the metals – Note that the kind of metal (cation or anion) must be considered- increasing the soil pH to 6.5, draining wet soils, applying phosphates, carefully selecting plants for use on metal contaminated soil and phytoremediation.

Prevention of soil contamination is far less expensive then kind of remediation and much better for environment. Background knowledge of sources, chemistry and potential risk to toxic metals in contaminated soils is necessary for the selection of appropriate remedial option. Remediation of soil contaminated by heavy metals is necessary to reduce associated risks, make the land resources available for the agricultural production and hence food security and scale down land tenure problems.

REFERENCES

[1]. A.D.K. Banerjee, Heavy metal levels and solid phase speciation in street dusts of Delhi, India, *Environmental Pollution* **123** (2003) 95–105.

[2]. Afzal Shah, et al. (2011) "Comparative Study of Heavy Metals in Soil and Selected Medicinal Plants" , *Journal of Chemistry,* 2013, **5.**

[3]. C. Stihi, A. Bancuta, I.V. Popescu, M. Virgolici, V. Cimpoca, M. Gugiu and Gh. Vlaicu, Air pollution studies using PIXE and ICP Methods, *Journal of Physics: Conference Series*, **41**, 565 D.
[4]. I. Suciu, C. Cosma, M. Todica, S. D. Bolboaca, L. Jantschi, (2008). Analysis of soil heavy metal pollution and pattern in Central Transylvania, *Int. J. Mol. Sci.* **9**, 434.
[5]. Mohammad Jamal Khan, et al. (2011), ".The Effect of Using Waste Water on Tomato " , *Pak J Bot*, **43**, 1.
[6]. Nagajyoti PC, Lee KD, Sreekanth TVM (2010). Heavy Metals, Occurrence and Toxicity for Plants: a Review. *Environ Chem Lett.*, **8**(3): 199–216.
[7]. Wei B, Yang L (2010) A review of heavy metal contaminations in urban soils, urban road dusts and agricultural soils from China. *Microchem J* **94**(2): 99–107.
[8]. Mubofu EB, Bahemuka TE (1999). Heavy metals in edible green vegetables grown along the sites of the Sinza and Misimbazi Rivers in Dar es Salaam, *Tanzania Food Chem.* **66**: 63-66.
[9]. Gupta, P. K. "Soil, Plant, Water and Fertilizer Analysis", (1999), Botanica Publication.