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Ecological Risk Assessment for heavy metals in Roadside Soils of Mysuru, Karnataka

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ABSTRACT: Ecological risk is assessed through the heavy metals concentration in the soil. Soil samples were collected from roadsides of residential and traffic area of Mysuru. Heavy metal concentrations were measured using ICP-OES (Perkin Elmer Optima 8000). Hakanson method was used to identify ecological potential risk of heavy metals pollution. The concentration of heavy metals in residential area was in the order of Mn > Zn > Cr > Cu > Ni > Pb > Cd and in traffic area it was: Mn > Zn > Cr > Ni > Cu > Pb > Cd. Heavy metals input in roadsides of Mysuru are possibly caused by human activities such as automobiles, industrial, household activities, and from natural process by erosion and natural water flow. Ecological potential risk of heavy metals in residential area was in the order: Cu > Pb = Ni > Cr > Zn > Mn and in traffic area it was: Cd > Cu > Pb > Ni > Cr > Zn > Mn. The study show that the heavy metals pose low ecological risk while Cd of traffic area posed high ecological risk and indicate that soil is moderately to considerably pollute.

KEY WORDS: Heavy metals, Ecological risk factor, traffic area, residential area

I. INTRODUCTION

Heavy metal is one of the most important pollutants in the environment as a result of both anthropogenic and natural activities (Chibuike *et al.*, 2014). Vehicular exhaust and industrial activities are the major sources of soil contamination with heavy metals. Heavy metals have a potential to contaminate soil, which can be dispersed and accumulate in plants and animals, and taken in by humans through consumption. So heavy metal contamination has been a worldwide environmental concern with its potential ecological effect (Hu B, *et al.*, 2017).

Ecological risk factor (Erⁱ) is used for evaluation of anthropogenic influence on urban soil, and many studies were performed using these approaches (Mathias *et al.*, 2016). Ecological risk assessment evaluates the risk posed by pollutants in soils, and helps in the interpretation of soil quality. The present work deals with the following objectives: (1) to measure the concentrations of selected heavy metals (Cr, Ni, Mn, Zn, Cu, Pb and Cd) in soil and (2) to assess the ecological risk of metals in the study area.

II. RELATED WORK

Yousef Waheshi, *et al.*, (2017) determined heavy metals concentration (Cr, Co, Cu, Fe, Mn, Ni, Pb and Zn) in the sediments of Lake Edku. The metals content were in the order of Fe > Mn > Cr > Co > Zn > Cu > Ni = Pb. The enrichment factor (mean) for heavy metals of the study area was in the order of Co > Mn > Pb > Cu > Cr > Zn > Ni. The study area was practically unpolluted with respect to Cr, Fe, Ni and Zn according to the geoaccumulation index while the Igeo of Co indicated the lake is moderately to strongly pollute with Co. The Pollution Load Index (PLI) indicated that the study area was less polluted.

Riyad, *et al.*, (2015) assessed the concentration and ecological risk of heavy metals in urban soil contaminated by various anthropogenic activities in Baghdad city. The samples were acid digested and concentration of heavy metals such as Cd, Cr, Cu, Ni, Pb and Zn were measured using atomic absorption spectrophotometer. All the soil samples

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showed high contents of heavy metals except for zinc. Nemerow pollution indexes (16.33) were calculated and falling in the seriously polluted category and Ecological risk factor for Cd (672) in soil was very high and it was in high potential ecological risk category.

Mmolawa, *et al.*, (2011) determined the heavy metal pollution of roadside soils in Botswana. The concentration of Al, Co, Cu, Fe, Mn, Ni, Pb and Zn were determined by using four pollution assessment methods [Contamination Factor (CF), Enrichment factor ratios (EF), Geo accumulation index (Igeo) and Pollution Lead Index (PLI)]. The study area was divided into five zones such as FN (Francistown-Nata), GK (Ghanzi-kang), MG (Maun-Ghanzi), NM (Nata-Maun), and TS (Tshabong-sekoma). The results showed that FN, NM and MG were more polluted compared to GK and TS zones and the main source of pollution was vehicular emissions, human activities and also lithogenic occurrences.

III. MATERIALS AND METHODS

Study area

The Mysuru district is suffering from heavy traffic density day by day because of increase in the number of vehicles as the population is increasing in a drastic manner. The selected sampling sites for the present study are roadsides of Mysuru residential area (Site 1) and traffic area (Site 2). Mysuru is the second largest city in Karnataka, India. It has spread across an area of 128.42 sq Km and is located at 12°18'11"N 76°39'11"E. Mysuru city has population of 920,550 of which 497,138 are male and 493,138 are female as per Census of India 2011 and the total area covered by the city is 112.81 sq. km.

Soil sampling and analysis

Soil samples were collected from the top 10 cm using stainless steel trowel at a distance of 0 to 3 mts from roads having high traffic density and from residential area of Mysuru. The soil samples were air dried and passed through 2mm sieve and stored in self-sealing plastic bags. Samples were analyzed for heavy metal concentrations using ICP-OES (Perkin Elmer Optima 8000).

The risk posed by heavy metal contamination in the study area was assessed using Ecological risk factor.

Ecological risk factor (Er^i)

Ecological risk factor is used to measure the ecological risk of an element. It is obtained by the equation (Hakanson, 1980);

$$Er^i = Tr^i \cdot C_f^i$$

Where, Tr^i is the toxic response factor for a given element and, C_f^i is the contamination factor of that element.

The Tr^i values for the heavy metals according to Hakanson, (1980) are Cr - 2, Ni - 5, Mn - 1, Zn - 1, Cu - 5, Pb - 5 and Cd - 30. Er^i is classified into five categories; $Er^i < 40$ represents low ecological risk; $40 \leq Er^i < 80$ is moderate ecological risk; $80 \leq Er^i < 160$ indicates significant ecological risk; $160 \leq Er^i < 320$ is the high ecological risk; and $Er^i \geq 320$ is very high ecological risk.

IV. RESULTS AND DISCUSSION

Table 1: Concentration of heavy metals (mg/kg) in residential and traffic area soil of Mysuru

Sl.No	Heavy Metals	Roadsides of Mysuru residential area (Site 1)	Roadsides of Mysuru traffic area (Site 2)
1	Cr	35.77	48.43
2	Ni	26.89	45.29
3	Mn	275.62	320.51

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4	Zn	68.67	78.75
5	Cu	29.75	36.43
6	Pb	7.98	15.56
7	Cd	BDL	2.60

BDL- Below detection level

The source of contamination of soil by heavy metals may be as a result of traffic density and also their natural presence in the soil as they are non-degradable (Nriagu 1990, Adeyeye 2005). The heavy metals concentration in roadsides of residential area soil was in the order Mn > Zn > Cr > Cu > Ni > Pb > Cd and in traffic area it was in the order Mn > Zn > Cr > Ni > Cu > Pb > Cd. The heavy metal contents were higher in roadsides of traffic areas as compared with the roadsides of residential area; this may be due to difference in the density of vehicles.

Table 2: Ecological risk factor (Er^i) determined for heavy metals in residential and traffic areas soil of Mysuru

Sl.No	Heavy Metals	Roadsides of Mysuru residential area (Site 1)	Roadsides of Mysuru traffic area (Site 2)
1	Cr	0.78	1.06
2	Ni	1.95	3.3
3	Mn	0.2	0.07
4	Zn	0.72	0.82
5	Cu	3.3	4.0
6	Pb	1.95	3.85
7	Cd	-	259.8

The Table 2 shows the Ecological risk factor (Er^i) for heavy metals as related to soil samples collected from Mysuru area (site 1 and site 2). The Er^i values for metals ranged from 0.07 (Mn) to 259.8 (Cd). Ecological risk for Cr, Ni, Mn, Zn, Cu and Pb of sites 1 and 2 are coming under the category of low ecological risk while Cd of site 2 posed high ecological risk. The Er^i of Cd in soils of site 2 is of great concern because of its high toxic response factor. Cadmium is attributed to the wear and tear of tires and high traffic density on the national highway. Besides cadmium can move for longer distances from the source of emission through atmospheric transport. Besides cars, trucks, various kinds of fasteners, industrial tools, bolts, nuts, nails and wrenches have also cadmium covering (Adriano, 2001). Overall Mysuru showed low ecological risk for the studied metals.

V. CONCLUSION

The heavy metals under investigation in the roadside soils reflected a low ecological risk with an exception for cadmium, which posed a high ecological risk in the roadsides of traffic areas. The results of soil samples collected from roadsides of residential and traffic areas showed that the area has been slightly contaminated by heavy metals and its pollution can be attributed to density of vehicles. Continuous assessment of heavy metals in the area is required to establish the background data which could be used globally.

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REFERENCES

1. Adeyeye, E. I. Trace metals in soils and plants from Fadama farms in Ekiti state, Nigeria. *Bulletin of chemical Society of Ethiopia*, 19, 23-24, 2005.
2. Adriano, D. C. Trace Elements in Terrestrial Environments: Biogeochemistry, Bioavailability, and Risks of Metals. 2nd Edition, *Springer Verlag*, 2001.
3. Chibuike, G. U., and Obiora, S. C. Heavy Metal Polluted Soils: Effect on Plants and Bioremediation Methods. *Applied and Environmental Soil Science*, <http://dx.doi.org/10.1155/2014/752708>, 2014.
4. Hakanson, L. An ecological risk index for Aquatic pollution control. A Sedimentological Approach. *Water Research*, 14, 975 – 1001, 1980.
5. Hu, B., Zhou, J., Liu, L., Meng, W., Wang, Z. Assessment of Heavy Metal Pollution and Potential Ecological Risk in Soils of Tianjin Sewage Irrigation Region, North China. *J Environ Anal Toxicol* 7:425. doi: 10.4172/2161-0525.1000425, 2017.
6. Mathias, O. Nweke., and Stephen, N. Ukpai. Use of Enrichment, Ecological Risk and Contamination Factors with Geoaccumulation Indexes to Evaluate Heavy Metal Contents in the Soils around Ameka Mining Area, South of Abakaliki, Nigeria. *Journal of Geography, Environment and Earth Science International*, 5(4), 1 – 13, 2016.
7. Nriagu, J. O. Global metal pollution: Poisoning the biophere. *Environment Envtar*, 32(9), 7-11, 28-33, 1990.
8. Yousef Ahmed Annaas Waheshi., Maie Ibrahim El Gammal., Mahmoud Salem Ibrahim. and Mohamed Abdel Aziz Okbah. Distribution and assessment of heavy metal levels using geoaccumulation index and pollution load index in lake Edku sediments, Egypt. *International Journal of Environmental Monitoring and Analysis*, 5(1), 1-8, 2017.
9. Riyad Al Anbari., Abdul Hameed M. J. Al Obaidy. and Fatima H. Abd Ali. Pollution loads and ecological risk assessment of heavy metals in the urban soil affected by various anthropogenic activities. *International journal of advanced research*, 3(2), 104-110, 2015.
10. Mmolawa, K. B., Likuku, A. S. and Gaboutioeloe, G. K. Assessment of heavy metal pollution in soils along major roadside areas in Botswana. *African Journal of Environmental Science and Technology*, 5(3), 186-196, 2011.
11. Cevik, F., Goksu, M., Derici, O. and Findik, O. (2009). An assessment of metal in surface sediments of Seyhan dam by using enrichment factor, geoaccumulation index and statistical analyses. *Environmental Monitoring and Assessment*, 148, 291-305.
12. Yousef Ahmed Annaas Waheshi., Maie Ibrahim El Gammal., Mahmoud Salem Ibrahim. and Mohamed Abdel Aziz Okbah. (2017). Distribution and assessment of heavy metal levels using geoaccumulation index and pollution load index in lake Edku sediments, Egypt. *International Journal of Environmental Monitoring and Analysis*, 5(1), 1-8.