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RESEARCH NOTE

Determination of heavy metals in water of Ganga and Yamuna river basin in Allahabad

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SUMMARY : The objectives of this paper were to illustrate the distribution and levels of sediment contamination by heavy metals in the Allahabad city, and to compare recent data with those collected during the early 2001. The metals as, Cd, Ni, Cu, Fe, Pb, Co, Ni and Zn were chosen because of their abundance and toxic effects in the environment of highly industrialized and urbanized areas. The pollutants, which do not remain in water column or solution, could be absorbed rapidly by particulate matters and thereby they also could escape any detection by water monitoring schemes (Meiggs, 1980). Some heavy metals like Cd, Cu, Fe, Ni and Pb were determined in water from four reaches of the river from Yamuna (river-km 1112) upstream from Sangam to Arail Ghat (river-km 851) downstream from Allahabad.

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The river Ganga is a part and parcel of everyday life in the city and thousands of people bath daily in the river Ganga and Yamuna. The largest tributary of river Ganga has been one of the most prominent and important rivers of India. The river, draining the southern slopes of the Himalaya in its upper reaches, is the largest tributary of the Ganga (Negi, 1991). The availability of good quality water is an indispensable feature for preventing diseases and improving quality of life (Oluduro and Adewoye, 2007). Natural river water contains some types of impurities whose nature and amount vary with source of water. Metals for example, are introduced into an aquatic system through several ways which include, weathering of rocks and leaching of soils, dissolution of aerosol particles from the atmosphere and from several human activities, including mining, processing and the use of metal based materials (Ipinmoroti and Oshodi, 1993; Adeyeye, 1994 and Asaolu *et al.*, 1997). Metals after entering the water many be taken up by fauna and flora and eventually, accumulated in marine organisms that are consumed by human being (Asaolu *et al.*, 1997). Pressure on the river is increasing enormously due to ever increasing population, industrial and urban growth in the river basins. It is of relatively recent recognition that stalinization of water resources is a major and widespread phenomenon of possibly even greater concern to the sustainability of irrigation than is that of the stalinization of soils, per second these metals in various organs of marine creatures ultimately lead to metal related diseases in the long run because of their toxicity, thereby endangering the aquatic biota and other organisms (Watling, 1983; Lee and Cundy, 2001; Melville and Burchett, 2002). Cadmium is principally dispersed in natural and agricultural environments through various agricultural, mining and industrial activities as well as resulting from the exhaust gases of automobiles (Das *et al.*, 1997). This trace metal is pollutant and potential toxin that has no known function in any biological organism, and is one of the most dangerous heavy metals for the environments due its high mobility and low concentration in organisms. The two most important factors that

Table 1 : Heavy metal concentrations (mg/l) in water of the Allahabad river basin

Sites	Heavy metal concentration (mg/l)					
	Cr	Cd	Ni	Fe	Pb	Mn
Old Bridge (W_1)	0.29±0.005	0.029±0.005	0.234±0.0009	1.223±0.0289	0.254±0.0167	0.010±0.0054
Arail Ghat (W_2)	0.16±0.0075	0.33±0.0013	0.345±0.0093	1.939±0.0494	0.284±0.0525	0.013±0.0127
Sangam (W_3)	0.13±0.0041	0.027±0.0020	0.094±0.0014	0.536±0.0087	0.248±0.0020	0.036±0.0149
Saraswati Ghat (W_4)	0.003±0.0094	0.020±0.0009	0.060±0.0025	1.109±0.0159	0.166±0.0387	0.055±0.0017

contribute to the deleterious effects of heavy metal as pollutants are their indestructible nature through bioremediation unlike organic pollutants and their tendency to accumulate in environment especially in the bottom sediments of aquatic habitats in association with organic and inorganic matter (Forstner and Wittmann, 1983). The observed values of various heavy metal parameters of water samples were compared with standard values recommended by ISI standards.

The area chosen for this study is Allahabad ($25^0 25' 28"$N and $81^0 53' 2"$ E) which is a natural wetland located between two rivers, Yamuna on its West and Ganga on its East. The freshwater enters through rivers, stream and agricultural drains. The river has rich aquatic life and the river has always been exploited by local population. Water samples were taken at different places at each station by a PVC tube column sampler at depth of half meter from the water surface. The samples at each station were mixed in a plastic bucket and a sample of 1 lit. was placed in a polyethylene bottle, kept refrigerated and transferred cold to the laboratory for analysis. To determine level of metals, Cu, Mn, Fe and Pb in water, 5 ml of water samples were digested at 80^0C with nitric acid and perchloric acid solution (3:1 v/v). Samples were allowed to cool, dissolved in 0.6 per cent HNO_3 and filtered through Whatman Filter Paper No. 42. Volume of each samples was maintained up to 10 ml with 0.6 per cent HNO_3 and analyzed by atomic absorbance spectrophotometer. The data were analyzed through the standard method of the statistical analysis (T-test).

Table 1 shows the water quality constituents of Old bridge (W_1), Arail Ghat (W_2), Sangam (W_3) and Saraswati Ghat (W_4) water, with reference to freshwater values and other global published values in different continents. In water samples, according to analysis results, the following findings were obtained for the concentration ranges of the metals: Cd: 0.020 - 0.33 mg/l; Cr: 0.003 – 0.29 mg/l; Mn: 0.010 – 0.055 mg/l; Fe: 0.536 – 1.939 mg/l; Ni: 0.060 – 0.345 mg/l and Pb: 0.166-0.284 mg/l were found. Heavy metal concentrations in the river water were decreased in the sequence of Fe > Ni > Cd > Cr >Pb>Mn.

The Cd, Cr, Cu, Fe, Ni and Pb concentrations of water in the four sampling sites were compared with International Standards. The obtained results showed that, with the exception of Fe, the heavy metal concentrations in water did not exceed WHO (World Health Organization, 1993), EPA (Environment Protection Agency, 2002), guidelines (Table 1). Fe content was found highest and Mn was found the lowest in water Jain and Sharma, 2009, Sarkar *et al.*, 2007 and Malik *et al.*, 2010. Gupta *et al.* (2009) have reported that the concentration of Fe in the water of river Ganges at Allahabad was highest and followed by Ni, Cd, Cr, Pb and Mn. More reliable guidelines for water quality control and contamination impact studies can be drawn to work on these lines in forth coming investigation.

Conclusion :

The results indicated that there were differences in trace metal concentration in water. At Old Bridge the concentration of metallic elements was higher in water samples than what it was found in Sangam while the opposite was true for water samples from the Saraswati Ghat and Arail Ghat. Present results indicate that Ganga and Yamuna basins have significant basal contamination levels that do not reach those of clearly polluted areas. However, there is need for continuous monitoring of pollution levels in the river.

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