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RESEARCH ARTICLE

DETERMINATION OF HEAVY METALS IN WATER OF GANGA AND YAMUNA RIVER BASIN IN ALLAHABAD

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ABSTRACT

This research established the presence of toxic metals in the river fauna for a follow up study to determine how the human and aquatic lives have been affected by accumulation of metals. All of their sewage - over 1.3 billion liters per day - goes directly into the Ganga and Yamuna river, along with thousands of animal carcasses, mainly cattle (Bharadwaj *et al.,* 2011).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. Four reaches of the river from Yamuna (river-km 1112) upstream from Sangam to Arail Ghat (river-km 851) downstream from the Allahabad. The total mean value were in the order of Fe > Co > Ni> Cu >Pb. The metal concentrations (mean ± standard deviation (SD) in µg/g dry weight) were Fe, 42.03 ± 1.11; Cu, 5.82 ± 0.21; and Pb, 0.44 ± 0.02.

INTRODUCTION

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). Pressure on the river is increasing is 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, *et al*., 2001; Melville *et al*., 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 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. Out of the several heavy metals in the industrial waste streams (Forstner *et al.*, 1983). The observed values of various heavy metal parameters of water samples were compared with standard values recommended by ISI standards.

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MATERIALS AND METHODS

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 the through rivers, stream and agricultural drains. The river has rich aquatic life; the river has always been exploited by local population (Figure 1).

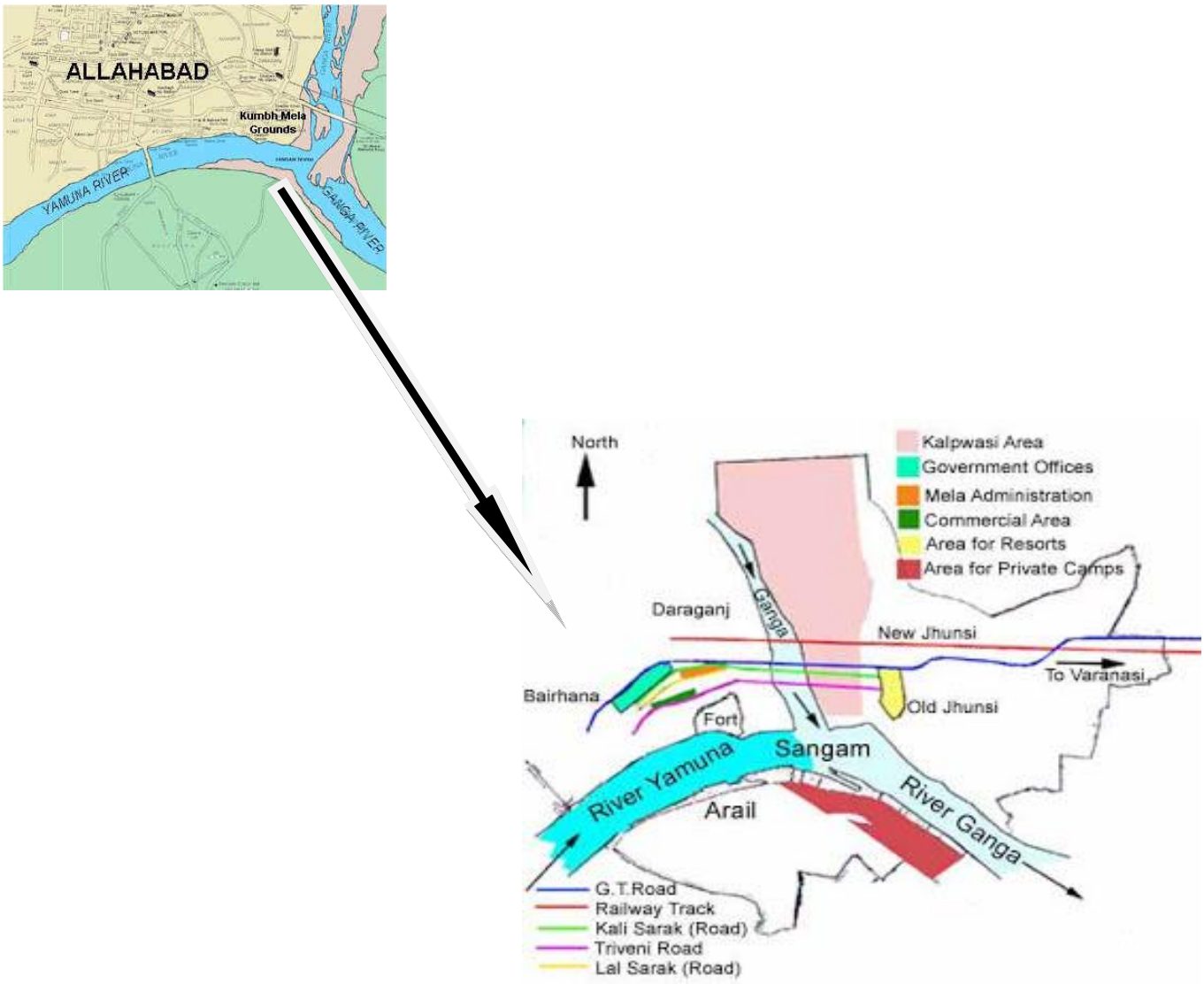

Figure 1. Geographical distribution of sampling sites in Ganga and Yamuna river, Allahabad

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

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 liter 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) (Kisku *et al.,* 2000). Samples were allowed to cool, dissolved in 0.6% HNO_3 and filtered through Whatman Filter Paper No. 42. Volume of each samples were maintained up to 10 ml with 0.6% HNO_3 and analyzed by atomic absorbance spectrophotometer. The data was analyzed through the standard method of the statistical analysis (T-Test).

RESULTS AND DISCUSSION

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 – 1.936 mg/l; Ni: 0.060 – 0.345 mg/l and Pb: 0.166-0.234 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 (2001), 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 work on these lines is investigated to be taken up in forth coming investigation.

Conclusion

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

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