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Monitoring of Trace Metals in Gagan River Water at Moradabad

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Ten different trace metals in Gagan river water at thirteen different sites in and around Moradabad were estimated by ICP-AES technique and the data was compared with water quality standards prescribed by W.H.O. River was found to be excessively contaminated for copper, iron, lead concentrations and moderately contaminated for nickel and cadmium. Chromium and manganese concentrations were within desirable limits, whereas, silver was absent at all the sites. River water was found to be encriched with zinc, micro-nutrient. Downstream samples after the mixing up of effluents indicated a marked decrease in river water quality for trace metals studied. People exposed to river water might be suffering from the toxicity of trace metals.

KEYWORD

River water, Effluents, Trace metal, Toxicity.

INTRODUCTION

Trace metals and their toxicity is the concern of present due to their natural abundance and by virtue of their universal usage in all spheres of life in their different chemical forms as ingredients of several compounds in the form of metals, inorganic and organic salts, and complexes, etc. Over-mobilisation of metals and their compounds in the environment, especially through the atmosphere and aquatic systems has been now identified one of the problem areas, since, these constitute the

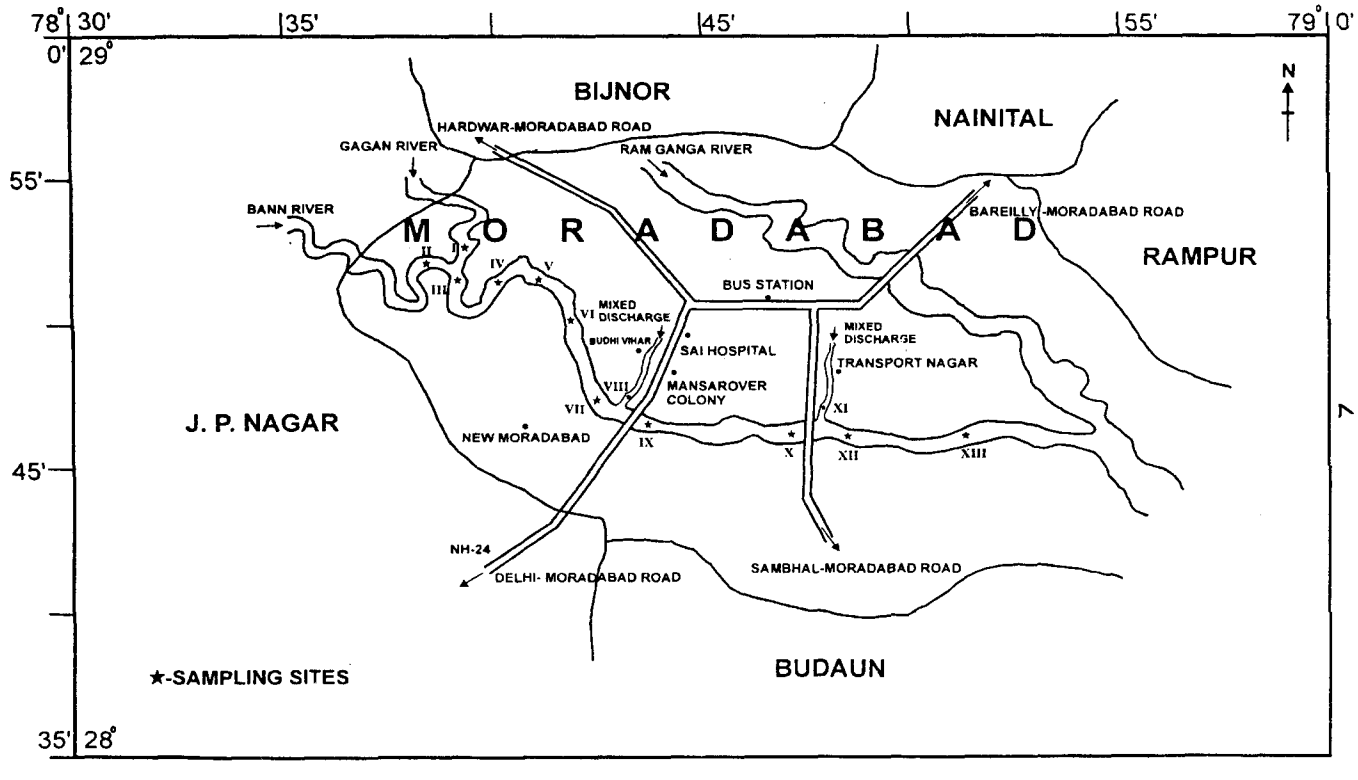

Figure 1. *Map of sampling sites*

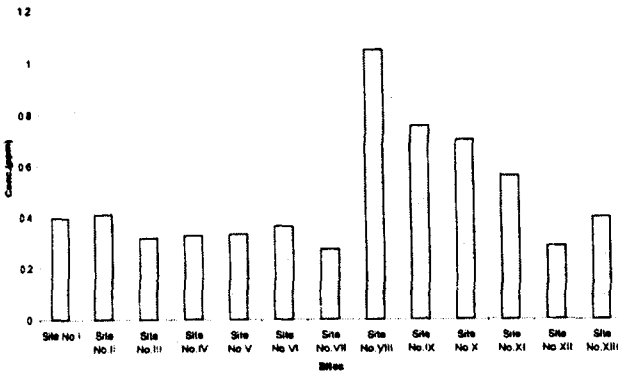

Figure 2. *Site-wise variation of chromium*

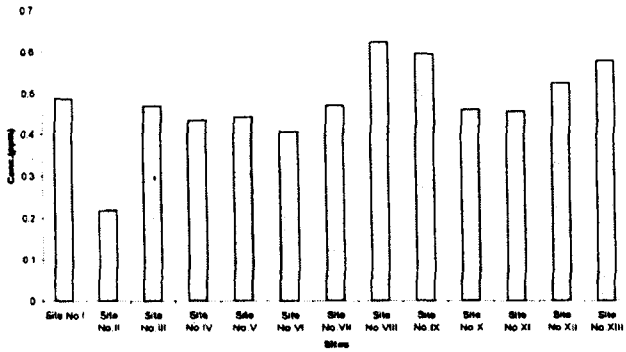

Figure 2. *Site-wise variation of copper*

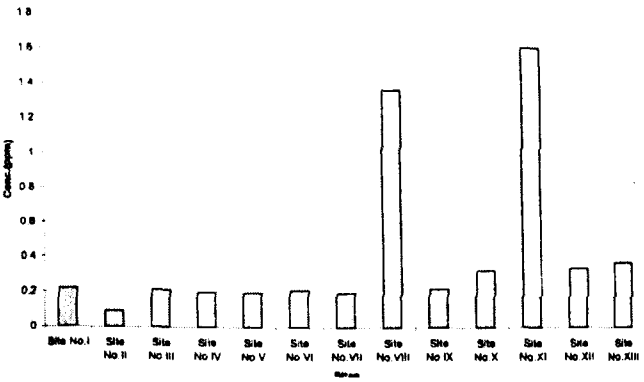

Figure 4. *Site-wise variation of manganese*

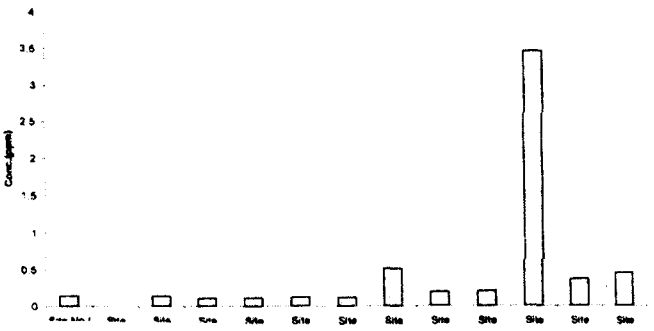

Figure 5. *Site-wise variation of nickel*

major routes of exposure to human beings as well (Sinha, 2004; Prajapati, 2004; Sinha 1995). Several adverse reports on metal exposure and toxicity have made human being more conscious all over the world. (Khan, 2005; Aktas, 2005).

Heavy metals ingested by the human body beyond tolerable limits can have severe consequences for health. Children and pregnant women are more prone to toxicity of heavy metals. Copper in higher amount is attributable to the corrosive action of water. Persons exposed to cadmium are reported to have adverse effects, like bronchitis, emphysema anaemia and renal stones. Lead poisoning is becoming a serious problem in many industrial and city areas. It affects the central nervous system. Excess iron concentration causes staining of clothes and utensils. The limits of iron in water are based on aesthetic and taste consideration rather than its physiological effects. Zinc is an important micro-nutrient. Cobalt is a poisonous metal. Chromium and nickel are carcinogenic. The harmful effects in man are due to hexavalent chromium. Its high concentration results in liver, intestinal and lung cancer, narcosis, nephrites and even death (De, 1995).

Moradabad is a 'B' class city of western Uttar Pradesh. It is situated at the bank of Ram Ganga river, its altitude from sea level is about 670 feet and is at 28°20', 29°15' N and 78°4', 79°E. Moradabad has seen rapid industrialization and population growth during last few decades. Most of the industries are dumping their effluents in two major rivers of the city-Ram Ganga and Gagan. City discharge, sewage discharge and different kinds of human activities are multiplying river water pollution.

MATERIAL AND METHOD

Ten different sites in and around Moradabad were selected for the collection of Gagan river water samples. Two effluent samples carrying mixed discharge of industries and nearby locality before mixing up with river water were collected at site no. VIII and XI. One Bann

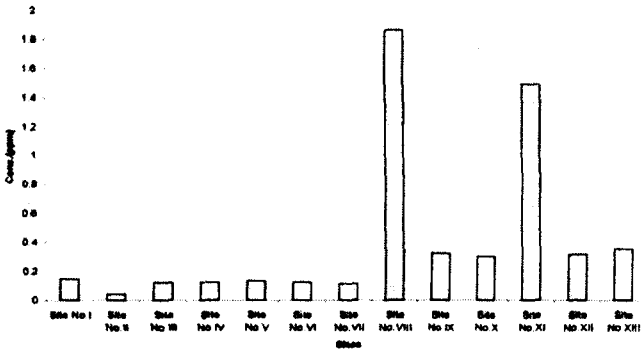

Figure 6. *Site-wise variation of lead*

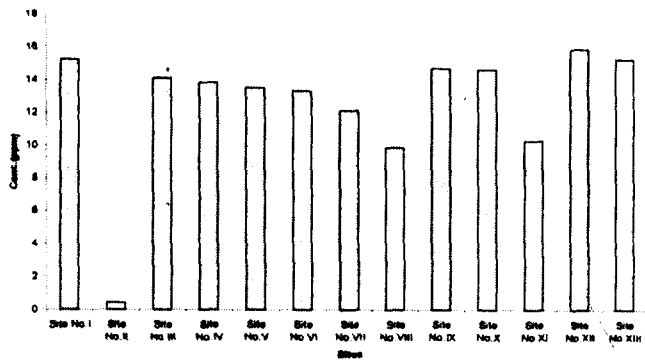

Figure 7. *Site-wise variation of cobalt*

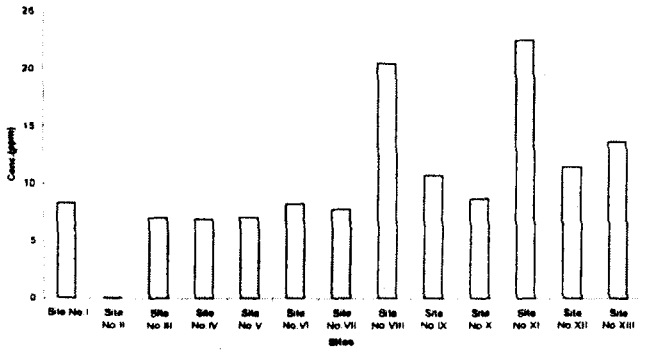

Figure 8. *Site-wise variation of iron*

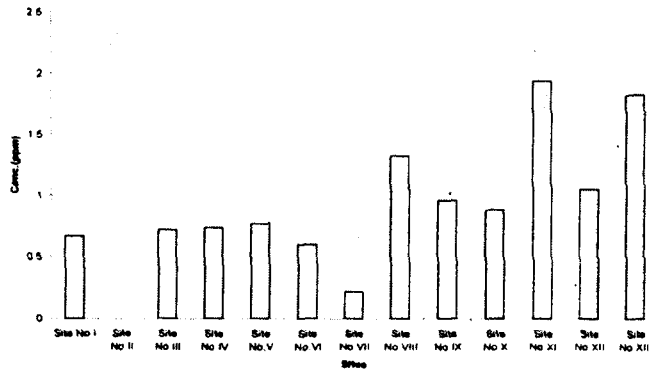

Figure 9. *Site-wise variation of zinc*

river water sample before mixing up with Gagan river was also collected All the samples were collected following standard procedure of sampling. (APHA, 1995; Cahill, 1769). Ten trace metals, namely chromium, copper, manganese, nickel, lead, cobalt, iron zinc, cadmium and silver were estimated by ICP-AES technique using Varian's Liberty AX sequential ICP-OES. A brief description sampling sites is presented in table 1. Map of sampling sites can be viewed in figure 1.

RESULT AND DISCUSSION

Site-wise estimated amount of different trace metals in Gagan river water at Moradabad with their W.H.O. standards are presented in table 2. Site-wise variation of chromium, copper, manganese, nickel, lead, cobalt, iron, zinc and cadmium can be viewed in figures 2 to 10, respectively. A critical analysis of the data and its comparison with W.H.O. standards revealed following facts regarding the trace metal toxicity in Gagan river water at Moradabad. Concentrations of chromium and manganese metals are within the prescribed limits except at a very few sites where chromium is on slightly higher side. There is no prescribed standard for cobalt, however, low concentrations are desirable and river water is observed to have moderate concentrations. Silver is absent invariably at all the sites including effluents. The observed range of nickel and cadmium indicated that river water is moderately contaminated for nickel and cadmium metals. The estimated range of copper and iron concentration in river water is 0.433-0.595 ppm and 9.840-15.850 ppm, respectively. The river water is excessively contaminated for copper and iron metals invariably at all the sites of study. The observed range of zinc is 6.810-20.380 ppm an desirable limit is 5.0 ppm. Inference can be drawn that river water is enriched with an essential micronutrient, zinc. Comparison of data of downstream samples with upstream samples indicate that river water quality with reference to studied trace metals is further deteriorated with the mixing up of effluents.

CONCLUSION

Chromium and manganese metal concentra-

Table 1. *A brief description of sampling sites*

Site no. and Name	Location of site	Noticed activities	Apparent water quality
I, U/S river at Sirsa Manihar	25 km West to Moradabad city	Nil	Objectionable odour, colour 450 units
II, Bann river at Sirsa Manihar	West to Moradabad city	Occassional bathing and fishing	Odourless, colourless, flora and fauna in good quantity
III, D/S river at Sirsa Manihar	50 m East to site no.II	Nil	Objectionable odour and colour
IV, River at Taiya-Moda	6 km North-East to site no.1	Nil	Odourless, colour 250 units
V, River at Chaudharpur	6 km from Taiya-Moda, site no.IV	Very occassional funeral activities	Odourless, colour 400 units
VI, River at Malgadda	8 km West to Moradabad city	Receives agricultral run off	Odourless, colour 150 units
VII, U/S river at Mbd -Dlh bridge	About 4.5 km East to site no. VI	Sand digging, cattle bathing and laundering of clothes	Appears contaminated
VIII, Mixed *discharge* at Mbd-Dlh bridge	50 m East to site no. VII	Nil	Pungent smell of H_2S, colour 420 units
IX, D/S river at Mbd-Dlh bridge	50 meter to mixing up of effluent of site no. VIII	Sand digging, occa-ssional funeral activities	Appears contaminated with objectionable odour
X, U/S river at Mbd-Sambhal bridge	3.5 km East to site no. IX	Occasional human and cattle activity	Not good
XI, Mixed discharge at Mbd-Sambhal bridge	50 m East to site no. X	Nil	Objectional pungent smell, colour 450 units
XII, D/S river at Mbd-Sambhal bridge	50 m to site no. XI	Nil	Objectionable odour
XIII, River at Seekandarpur-Patti	16 km East to site No. X	Receives agricultual run off	Water quality appears better

tions are observed to be well within the prescribed limit. River water is observed to have moderate concentration of cobalt. Silver is absent invariably at all the sites. River water is found to be excessively contaminated for copper, lead and iron concentrations. It is moderately contaminated with reference to nickel and cadmium metals. Gagan river water is reported to be enriched with zinc which is an essential micro-nutrient. Mixing up of effluents are playing their vital role in multiplying the trace metal contamination of river water. Residents exposed to Gagan river water are prone to health hazards of estimated trace metals. River water quality management with reference to almost all studied trace metals is urgently needed in the catchment area of study.

ACKNOWLEDGEMENT

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Table 2. *Site-wise estimated amount of different trace metals in Gagan river water at Moradabad, in ppm*

Trace metal	Site I	Site II	Site III	Site IV	Site V	Site VI	Site VII
Chromium (Cr)	0.394	0.406	0.315	0.325	0.331	0.361	0.271
Copper (Cu)	0.487	0.218	0.469	0.433	0.442	0.406	0.469
Manganese (Mn)	0.219	0.094	0.214	0.198	0.195	0.210	0.195
Nickel (Ni)	0.138	Nil	0.131	0.105	0.111	0.119	0.121
Lead (Pb)	0.667	Nil	0.718	0.735	0.772	0.600	0.221
Cobalt (Co)	0.146	0.043	0.123	0.125	0.134	0.126	0.113
Iron (Fe)	15.230	0.450	14.100	13.850	13.500	13.321	12.112
Zinc (Zn)	8.316	0.051	6.950	6.810	6.980	8.140	7.710
Cadmium (Cd)	0.311	Nill	0.305	0.290	0.300	0.306	0.272
Silver (Ag)	Nil	Nil	Nil	Nil	Nil	Nil	Nil

Table 2. *(continue)*

Trace metal	Site VIII	Site IX	Site X	Site XI	Site XII	Site XIII	Site XIV
Chromium (Cr)	1.041	0.746	0.694	0.557	0.283	0.397	0.5
Copper (Cu)	0.624	0.595	0.460	0.455	0.523	0.577	0.05
Manganese (Mn)	1.342	0.216	0.318	1.576	0.332	0.362	0.1-0.5
Nickel (Ni)	0.515	0.195	0.211	3.465	0.369	0.452	0.02
Lead (Pb)	1.328	0.965	0.890	1.950	1.059	1.836	0.1
Cobalt (Co)	1.863	0.324	0.302	1.485	0.315	0.353	-
Iron (Fe)	9.840	14.680	14.581	10.260	15.850	15.250	0.1
Zinc (Zn)	20.380	10.640	8.600	22.410	11.370	13.600	5.0
Cadmium (Cd)	1.100	0.342	0.351	1.400	0.365	0.411	0.05
Silver (Ag)	Nil	Nil	Nil	Nil	Nil	Nil	-

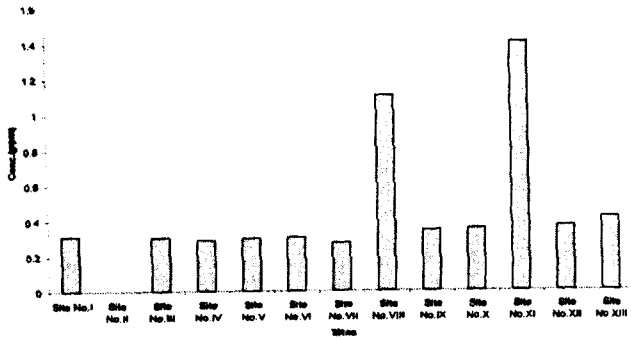

Figure 10. *Site-wise variation of cadmium*

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