Monitoring and assessment of trace metals in water and sediment of some rivers around Dhaka city, Bangladesh

Md. Saiful Islam* and Shigeki Masunaga

Faculty and Graduate School of Environment and Information Sciences, Yokohama National University, Japan

Introduction: The present study observed the situation of the rivers (Turag, Buriganga and Shitalakha) around Dhaka city, Bangladesh. The greater Dhaka city is one of the most densely populated area in the world with approximately 12 million people of which less than 25% are served by sewage treatment facilities. Sediments and surface water are most vulnerable to various pollution including trace metals due to their ease of access for the disposal of urban and industrial waste water. Trace metals from natural and anthropogenic sources pose serious threats to the environment and human health due to their long persistence, toxicity and bio-accumulation. Hence, trace metals are vital indicators for monitoring the change of aquatic environment. Sediments can scavenge some elements, thus acting as an adsorptive sink with metals and is regarded as possible sources of the contaminants into the water column due to remobilization, desorption, degradation of sorptive substances and redox reactions.

Objectives: To assess the contamination of trace metals and their spatial and seasonal distribution in aquatic environment

Study area and methods

1. Sampling:

Eighteen pairs of water and sediment samples were collected in March 2012 (winter) and September 2012 (summer).

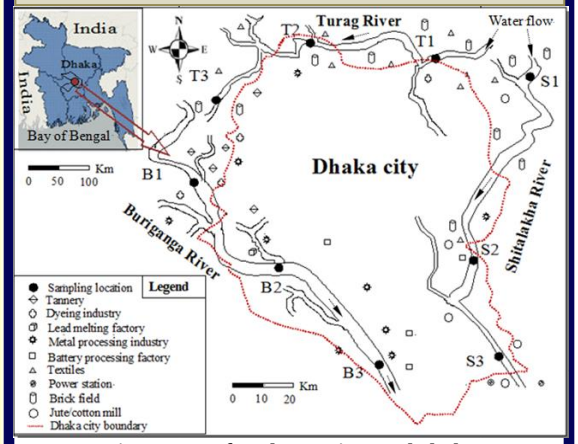

Fig. 1. Map of study area in Bangladesh

2. Analytical procedure:

0.2 g sediment /20 ml water sample

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5 ml 69% HNO_3 (Kanto chemical Co, Japan) + 2 ml 30% H_2O_2 (Wako chemical Co, Japan)

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Digestion by using microwave digestion system

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Filtration by DISMIC® -25HP PTTF (0.45 µm) syringe filter

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Metal analysis by using ICP-MS (Agilent, 7700 series)

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Conclusion: This study has shown that the sediment of the rivers was heavily polluted with trace metals, especially Cd and Pb in sediment. As some of the selected metals exceeded the safe levels, therefore, it suggested that the water from contaminated sites should not be used without treatment. Finally it is concluded that the further detailed assessment of these two vital metals are highly recommended of the study area.

Results and Discussions

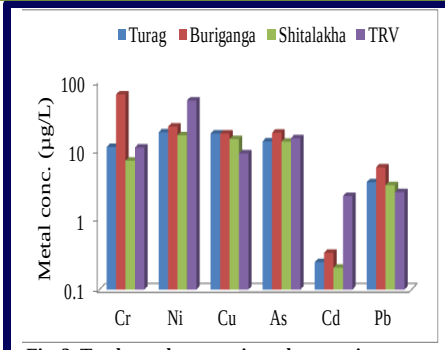

Fig. 2. Total metal content in and comparison with Toxicity Reference Value (TRV)

- Among three studied rivers, Buriganga River exhibited higher than other two rivers.
- Some of the metals exceeded the Toxicity Reference Value (TRV) for safe fresh water.

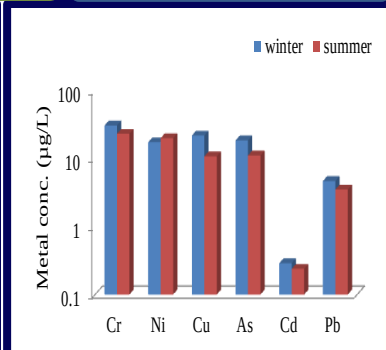

Fig. 3. Seasonal variation of trace metals in water sample

- Metals in water during winter was higher than those during summer and the lower levels during summer might be due to the dilution effect of water.

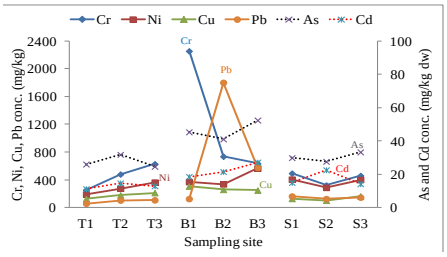

Fig. 4. Metals in sediment of three different rivers

- Waste from tanneries was the most probably responsible for the highest Cr concentration in Buriganga River.
- Higher Ni, Cd and Pb in sediment of Buriganga River might be due to the industrial activities, atmospheric emission, leachates from defused Ni-Cd batteries and Cd plated items.

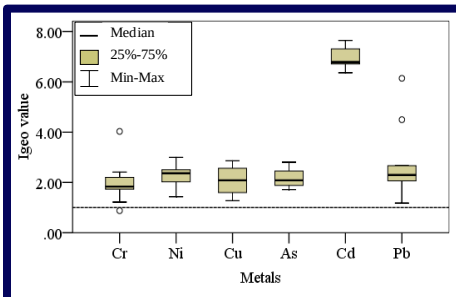

Fig. 5. *I*geo values of trace metals in sediment

$$I_{geo} = \log_2[C_n/1.5B_n] \quad \ldots.(1)$$

- Geo-accumulation index (I_{geo}) was used to assess metal accumulation in sediment and measure the degree of metal pollution.
- The frequency of *I*geo value of metals; Cd > Pb > Cr > Ni > Cu > As.
- The highest *I*geo values for Cd (6.4 - 7.7) indicated extreme contamination. For other metals, moderately to extremely polluted.

Table 1. Comparison of metal content in sediment and Sediment Quality Guideline (mg/kg)

SQG of USEPA	Cr	Ni	Cu	As	Cd	Pb
Non polluted	< 25	< 20	< 25	< 3		< 40
Moderately polluted	25-75	20-50	25-50	3-8		40-60
Heavily polluted	> 75	> 50	> 50	> 8	> 6	> 60
This study average	695	355	191	35	17	356

- The SQGs of USEPA, strict criteria, were used to distinguish sediment quality. The average values of all the metals belonged to the class of heavily polluted.

Reference: US EPA (1999) Screening level ecological risk assessment protocol for hazardous waste combustion facilities. Vol. 3, Appendix E: Toxicity reference values. EPA 530-D99-001C.

islam-md.saiful-nj@ynu.ac.jp