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

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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.

Study area and methods

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

2. Analytical procedure:
0.2 g sediment /20 ml water sample
5 ml 69% HNO3 (Kanto chemical Co, Japan) + 2 ml 30% H2SO4 (Wako chemical Co, Japan)
Digestion by using microwave digestion system
Filtration by DISMIC®-25HP PTF (0.45 µm) syringe filter
Metal analysis by using ICP-MS (Agilent, 7700 series)

Results and Discussions

Fig. 2. Total metal content in 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

Fig. 5. Igeo values of trace metals in sediment

Igeo = log10(Cn/1.5Bn) (1)
➢ Geo-accumulation index (Igeo) was used to assess metal accumulation in sediment and measure the degree of metal pollution.
➢ The frequency of Igeo value of metals; Cd > Pb > Cr > Ni > Cu > As.
➢ The highest Igeo 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)

<table>
<thead>
<tr>
<th>Sediment Quality Guideline (mg/kg)</th>
<th>Cr</th>
<th>Ni</th>
<th>Cu</th>
<th>As</th>
<th>Cd</th>
<th>Pb</th>
</tr>
</thead>
<tbody>
<tr>
<td>Non polluted</td>
<td>&lt; 25</td>
<td>&lt; 20</td>
<td>&lt; 25</td>
<td>&lt; 3</td>
<td>&lt; 40</td>
<td></td>
</tr>
<tr>
<td>Moderately polluted</td>
<td>25-75</td>
<td>20-50</td>
<td>25-50</td>
<td>3-8</td>
<td>40-60</td>
<td></td>
</tr>
<tr>
<td>Heavily polluted</td>
<td>&gt; 75</td>
<td>&gt; 50</td>
<td>&gt; 50</td>
<td>&gt; 6</td>
<td>&gt; 60</td>
<td></td>
</tr>
<tr>
<td>This study average</td>
<td>695</td>
<td>355</td>
<td>191</td>
<td>35</td>
<td>17</td>
<td>356</td>
</tr>
</tbody>
</table>

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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.