

Geochemical and human health risk assessment for metal pollution in water environment around Kolkata landfill site

VANDANA PARTH * AND S. N. MUKHERJEE

Environmental Engineering Division, Civil Engineering
Department, Jadavpur University, Kolkata, India
(*Correspondence: vandana.parth@gmail.com)

A geochemical study was undertaken to examine the extent and health impact of fatal trace metals intrusion to surface and sub-surface water resources in and around uncontrolled landfill site of a metropolitan city in India. Water samples ($n=26$) were collected from the vicinity of landfill with different metal exposure scenario in Kolkata wetland environment. The intensity (μgL^{-1}) of toxic metals/metalloids (Cr 27.5 ± 15.4 , Mn 257.2 ± 330.9 , Co 0.5 ± 0.5 , Ni 4.0 ± 2.3 , As 18.4 ± 12.6 , Cu 5.3 ± 5.0 , Zn 292.7 ± 466.7 , Cd 0.2 ± 0.5 , Pb 1.0 ± 0.4 , V 36.8 ± 16.8) were observed on instrumental analysis of samples in DRC ICP-MS. A human health risk model derived from USEPA (1989) [1] was applied to compute potential non-carcinogenic hazard and carcinogenic risk for the population residing in the study area considering all possible exposure routes. Hazard Quotient (HQ ingestion and dermal) for non-carcinogenic risks in child and adult was calculated from the ratio of average daily dose to reference dose (ADD/RfD). The child HQ_{ing} , $\text{HQ}_{\text{dermal}}$ was estimated as $4.13\text{E}+00$ and $1.37\text{E}-01$ respectively, while adult HQ_{ing} , $\text{HQ}_{\text{dermal}}$ was determined as $2.48\text{E}+00$ and $1.11\text{E}-01$ respectively. The measured Cumulative Hazard Index for child ($\Sigma \text{HI} = 4.26\text{E}+00$) and adult ($2.59\text{E}+00$) reveals that toxic risk is beyond tolerable limit ($\text{HQ} > 1.00$). The assessment of carcinogenic effects of As and Pb was calculated from $\text{CDI}\times\text{SF}$ [2]. The estimated risk level for As exposure ($3.56\text{E}-04$) is exceeding the safe standard for cancer ($\text{CR}=1.0\text{E}-6$). Therefore, the present case investigation unveil that residents confront higher risks, with carcinogenic effects that average 4 in 10,000. However, the cancer risk due to Pb exposure ($1.11\text{E}-07$) is within the target cancer risk level. On the basis of these experimental survey, risk assessment would serve as an interim input for steps to be undertaken for remedial measures to reduce the exposure of inhabitants to carcinogenic risks. Also, the exercise may be fruitful as a decision making tool for the areas where such uncontrolled waste dumping site exist.

[1] USEPA Risk Assessment Guidance for Superfund (1989), *Human Health Evaluation Manual*, vol.1, Part A, EPA/540/1-89/002. [2] USEPA IRIS (2011), US Environmental Protection Agency's Integrated Risk Information System.