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Assessment of source apportionment and composition of trace elements in rainwater in the south-eastern region of Bangladesh

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Rainwater is considered as a dependable potable and non-potable water source, used for domestic purposes as well as for human consumption in many cases. While it is usually believed that rainwater is safe for drinking purposes, many studies have explored the existence of trace metals in harvested rainwater, which can impose a serious health risk to human beings when present in relatively high concentrations. The concentration of trace elements in atmospheric precipitation including rainwater also provides a good indication of the environmental pollution caused by anthropogenic activities.

Chattogram, located in the south-eastern side of Bangladesh, is the busiest port city and the second-largest city in the country with a population of around 4.5 million people. With the presence of high salinity and arsenic in groundwater and poor quality of surface water in the region, rainwater harvesting is the most sustainable solution to be considered in the water system management for the area, particularly given annual mean precipitation of 2488 mm during the rainy season. In recent years, extensive studies have been carried out on the potential application of different rainwater harvesting systems across the region, but there have been very few studies devoted to the identification of the composition of trace elements in rainwater considering site-specific influences in the trace metal distribution in the rainwater.

The purpose of this study was to investigate the composition and source appointment of trace metals (Fe, Cu, Zn, Pb, Mn, Cr, and Cd) in rainwater in the south-eastern region of Bangladesh. To determine their sources and relative contributions in rainwater, a total of ninety-five rainwater samples were collected in this study from five different locations representing different land-use patterns (industrial, commercial, urban, and sub-urban) within the study area, from June 2018 to October 2019. The collected water samples were analyzed for Fe, Cu, Zn, Pb, Mn, Cr, and Cd using Atomic Absorption Spectrophotometer maintaining standard protocols. The measured trace elements from the collected rainwater samples were then compared with the WHO and Bangladesh drinking water standards.

The resulting concentration of trace metals in this study was found within the allowable limits in accordance with WHO and Bangladesh drinking water standards, confirming the suitability of rainwater as a potable water source for human consumption. The average concentration of trace metals in rainwater was found in the order of Zn > Cu > Fe > Cr > Mn > Pb > Cd for the tested samples. Overall, the trace metal concentrations of Cu and Zn were predominantly observed in rainwater samples collected from the industrial area, indicating the influence of anthropogenic activities on atmospheric pollution. The concentrations of the trace elements in this work were found to be overall higher when compared to those reported in other investigations around the world. The measurements of this study would provide an indication of atmospheric pollution in rainwater caused by the anthropogenic origins of trace metals as well as provide a database of trace metals in rainwater for further relevant research studies across the country.