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# Groundwater Arsenic Contamination in Gangetic Jharkhand, India: Risk Implications for Human Health and Sustainable Agriculture

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**Abstract :** Arsenic contamination in groundwater has been a matter of serious concern worldwide. Globally, arsenic contaminated water has caused serious chronic human diseases and in the last few decades the transfer of arsenic to human beings via food chain has gained much attention because food represents a further potential exposure pathway to arsenic in instances where crops are irrigated with high arsenic groundwater, grown in contaminated fields or cooked with arsenic laden water. In the present study, the groundwater of Sahibganj district of Jharkhand has been analysed to find the degree of contamination and its probable associated risk due to direct consumption or irrigation. The present study area comprising of three blocks, namely Sahibganj, Rajmahal and Udhwa in Sahibganj district of Jharkhand state, India, situated in the western bank of river Ganga has been investigated for arsenic contamination in groundwater, soil and crops predominantly growing in the region. Associated physicochemical parameters of groundwater including pH, temperature, electrical conductivity (EC), total dissolved solids (TDS), dissolved oxygen (DO), oxidation reduction potential (ORP), ammonium, nitrate and chloride were assessed to understand the mobilisation mechanism and chances of arsenic exposure from soil to crops and further into the food chain. Results suggested the groundwater to be dominantly Ca-HCO3- type with low redox potential and high total dissolved solids load. Major cations followed the order of Ca ˃ Na ˃ Mg ˃ K. The concentration of major anions was found in the order of HCO3− > Cl− > SO42− > NO3− > PO43− varied between 0.009 to 0.20 mg L-1. Fe concentrations of the groundwater samples were below WHO permissible limit varying between 54 to 344 µg L-1. Phosphate concentration was high and showed a significant positive correlation with arsenic. As concentrations ranged from 7 to 115 µg L-1 in premonsoon, between 2 and 98 µg L-1 in monsoon and 1 to 133µg L-1 in postmonsoon season. Arsenic concentration was found to be much higher than the WHO or BIS permissible limit in majority of the villages in the study area. Arsenic was also seen to be positively correlated with iron and phosphate. PCA results demonstrated the role of both geological condition and anthropogenic inputs to influence the water quality. Arsenic was also found to increase with depth up to 100 m from the surface. Calculation of carcinogenic and non-carcinogenic effects of the arsenic concentration in the communities exposed to the groundwater for drinking and other purpose indicated high risk with an average of more than 1 in a 1000 population. Health risk analysis revealed high to very high carcinogenic and non-carcinogenic risk for adults and children in the communities dependent on groundwater of the study area. Observation suggested the groundwater to be considerably polluted with arsenic and posing significant health risk for the exposed communities. The mobilisation mechanism of arsenic also could be identified from the results suggesting reductive dissolution of Fe oxyhydroxides due to high phosphate concentration from agricultural input arsenic release from the sediments along river Ganges.

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