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Assessment of Uranium Contamination in Shallow Aquifers of Selected Semi-Urban Regions: A case study from Punjab India

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Uranium contamination in shallow aquifers has emerged as a critical groundwater-quality concern in several regions of India, posing significant risks to drinking-water safety and public health. This study assesses the spatial distribution, concentration levels, and hydro-geochemical controls of uranium in shallow groundwater systems of selected semi urban regions. The source of data used for this study was from Central Groundwater board (CGWB). For this study, the semi urban regions of Punjab has been taken as study area. Uranium concentrations exhibited substantial spatial variability, with several locations exceeding the World Health Organization and Bureau of Indian Standards permissible limits for drinking water. Geochemical evaluation indicates that uranium mobilization is strongly influenced by alkaline pH, bicarbonate-rich conditions, oxidizing environments. The findings showed the vulnerability of shallow aquifers to uranium contamination in semi urban regions of Punjab as very high. In uranium contaminant concentration of 2024 suggest that shallow aquifers in the Patran tehsil of the Patiala district in Punjab, India, had shown significant uranium contamination, with a large percentage of samples exceeding safe limits set by the World Health Organization (WHO). In the same year, maximum uranium concentration of 202 ppb has been observed in this region. More than the average concentration of 48 ppb has been observed in agricultural regions such as Kamalpur, Sangurur, Patiala. This study provides water-resource stakeholders to safeguard drinking-water security in uranium-prone regions of India.