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High prevalence of uranium in groundwater of Punjab : a comparative study of its distribution, potential source & health risk assessment

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The present study has been undertaken to assess the distribution of the uranium concentration in ground water along with the health risks associated with its ingestion, covering South-West (SW) and Northern (N) regions of Punjab State, India. The uranium concentration in ground water of SW and N Punjab has been observed to be varying from 2.8 to 645.2 $\mu\text{g l}^{-1}$ and BDL to 63.5 $\mu\text{g l}^{-1}$, with mean values of 84.7 and 6.0 $\mu\text{g l}^{-1}$, respectively. Seventy percent of the analyzed samples particularly from the SW-Punjab, exceeded the maximum permissible WHO(2011) limit of 30 $\mu\text{g l}^{-1}$ and even forty eight percent of the samples exceeded 60 $\mu\text{g l}^{-1}$, the limit recommended by AERB(2004) of India. The measured annual effective dose ranged from 9.9 to 1084.0 $\mu\text{Sv y}^{-1}$ and 0 to 106.7 $\mu\text{Sv y}^{-1}$ for SW & N Punjab, respectively. The chemical toxicity has been found to be in the range of 0.44 to 48.65 $\mu\text{g Kg}^{-1}\text{day}^{-1}$ with an average value of 6.38 $\mu\text{g Kg}^{-1}\text{day}^{-1}$ for SW region, which is quite higher than AERB recommended limit of 4.53 $\mu\text{g Kg}^{-1}\text{day}^{-1}$. The HQ for SW-Punjab was found to be greater than 1, indicating significant risk due to intake of uranium contaminated water from the SW region. However, the uranium concentration with its both radiological and chemical risks in all the analyzed groundwater samples from N-Punjab was observed to be well below the international and national recommended safe limits. The quite high levels of TDS, salinity and conductivity have also been observed particularly in SW-region of Punjab, which might have increased the leaching of uranium from soil, through the formation of carbonates and bicarbonates. Since the maximum uranium concentration in groundwater has been observed only at shallow depths only, thus mobilization of uranium from soil and sediments under favourable geochemical conditions seems to be the possible reason for high prevalence of uranium in SW-Punjab. But still at this stage the geogenic reasons also can not be ruled out, so reasons behind elevated level elevated levels prevalent in SW region and its source determination is still a kink. In SW-Punjab, it is being recommended to use the canal water for drinking purposes and domestic use by urban and rural populations than groundwater sources. In SW-Punjab, it is being recommended to use the canal water for drinking purposes and domestic use by urban and rural populations than groundwater sources.

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