

# **Hydrochemical and isotopic characteristics of groundwater in the Ghaggar River basin of Indo-gangetic Plain, India and its implications in the identification of suitable zones for artificial recharge**

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The groundwater table is declining at a faster rate in the northwestern part of the Indo-Gangetic basin due to overexploitation of the aquifer for irrigation. The State governments of Haryana and Punjab have initiated major programs for water level augmentation through artificial recharge interventions. A high-resolution hydrochemical study carried out in the Ghaggar River Basin of the northwestern Indo-Gangetic Basin reveals the significant variation of  $\delta^{18}\text{O}$ ,  $\delta^2\text{H}$ , EC,  $\text{NO}_3^-$  and  $\text{K}^+ \text{Na}^+$  parameters of groundwater on spatial as well as vertical scales in study area from proximal to distal part. Hydrochemical characteristics along the groundwater flow paths evolved from Ca-HCO<sub>3</sub> and Ca-Mg-Na-HCO<sub>3</sub> facies upstream to Na-HCO<sub>3</sub>, Ca-Mg-Cl-SO<sub>4</sub>, and Na-Cl-SO<sub>4</sub> water facies in the downstream of the basin (more evolved water) due to geological and anthropogenic factors. The variation in vertical movement of isotopic and chemical tracers indicates faster recharge rate in particular zones i.e. up to a depth of 80 m. The farmers are pumping excessive groundwater for irrigation in these recharge zones where recharging is faster, and groundwater is of good quality water. As a result, the water table declines at a very fast rate (~1m/yr) in these pockets. In contrast, the downstream side is not being pumped due to its saline nature. However, a dense network of canals has been developed for irrigation, which promotes irrigation returned flow to join the water table and causes to increase in the water table.

A significant variation in the hydro-chemical and isotopic characteristics of groundwater is the best indicator to identify the most suitable zone in the basin for water level augmentation through artificial recharge interventions. In the downstream zone of the basin, measures are to be adopted for lowering the water table through developed irrigation practices which will help in minimizing the groundwater salinity.