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## Hydrochemistry in integration with Stable Isotopes ( $\delta^{18}\text{O}$ and $\delta\text{D}$ ) to assess Seawater intrusion in coastal aquifers of Kachchh district, Gujarat, India

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### Abstract

Coastal aquifers are highly vulnerable to salinization, especially by seawater intrusion. This problem is exacerbated by increasing demands for freshwater in coastal zones due to urbanization and industrialization. This paper investigates seawater intrusion in coastal aquifers of Kachchh district in Gujarat, an economic hub of the country in western India. A total of 26 groundwater samples were collected from various villages of the district from Kandla to Mandavi. In this study hydro-chemical, stable isotope ( $\delta^{18}\text{O}$  and  $\delta\text{D}$ ) and GIS analysis were used to infer salinization processes. The origin of salinity and mixing of various water masses has been studied through the integration of major ions chemistry with stable isotopes  $\delta^{18}\text{O}$  and  $\delta\text{D}$ . Most of the samples were showing Na-Cl type water facies. It was observed that besides natural processes (such as water-rock interaction, ion exchange, dissolution/precipitation dynamics and evaporation) which are governing the groundwater quality, current land use practices have augmented the salinization in this poorly drained semi-arid area. Various ionic ratios (such as  $\text{Mg}^{2+}/\text{Ca}^{2+}$ ,  $\text{Na}^+/\text{Cl}^-$ ,  $\text{SO}_4^{2-}/\text{Cl}^-$ ,  $\text{K}^+/\text{Cl}^-$ ) and isotopic composition ( $\delta^{18}\text{O}$  and  $\delta\text{D}$ ) of groundwater suggest that while in coastal areas seawater intrusion and formation of saline plumes is taking place, due to upconing of underlying natural saline water which is enhanced by overexploitation. In inland areas groundwater quality is deteriorating due to infiltration of wastewater and irrigation return flow. The continued stress on land and water resources has shifted the natural balance and accelerated the salinization process in this water scarce region. For securing freshwater in future, the integrated water resources management is required which should also include calculation of groundwater budget in the coastal aquifer.

Keywords: Hydrochemistry; Ionic ratio; Seawater intrusion; Stable isotopes ( $\delta^{18}\text{O}$  and  $\delta\text{D}$ ); GIS; Coastal aquifers; Kachchh district.

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