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The distribution of saline and fresh groundwaters and factors affecting water quality in the coastal aquifers of southwest Bangladesh

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Abstract

People in the southwest coastal areas of Bangladesh are suffering from a potable water crisis. The groundwater development in this area is challenged by some natural processes. For the purposes of this research, emphasis is placed on revealing the factors controlling the water quality, and distribution of saline and fresh groundwaters using hydrochemical, geophysical and geostatistical analyses. Three aquifers have been identified in this area (Sarker et al., 2018): upper shallow aquifer (USA) (<100 m depth), lower shallow aquifer (LSA) (100-200 m depth) and deep aquifer (DA) (>200 m depth). The groundwater type based on Stuyfzand's (1989) classification shows that the water in USA is mostly of brackish saline NaCl- type. The water in LSA has similar characteristics like USA but is brackish. The presence of some CaCl and CaMix water types in shallow aquifers indicates reverse ion exchange process during saltwater intrusion. The water in shallow aquifers is derived from the dissolution of evaporite on the ground surface by monsoon precipitation as is confirmed by Cl/Br ratio and stable isotopes. DA comprises mostly fresh NaHCO₃+ type water and is formed by cation exchange process from infiltrating freshwater from the recharge area (Sarker et al., 2021). Direct seawater intrusion by lateral flow from the Bay of Bengal has no contribution to salinization in the shallow aquifers. Electrical resistivity tomography (ERT)

and vertical electrical soundings (VES) show no evidence of seawater intrusion in the coastal plain. The groundwater level data also illustrate north-south flow. A geostatistical analysis on selected ions of all the groundwaters allows identification of three major clusters that are hydrochemically comparable with the USA, LSA and DA. Factor analysis also shows that the groundwater is affected by evaporite dissolution, fresh saline water mixing, ion exchange and anthropogenic pollutants. The DA could be a good option for sustainable use of the groundwater resource in the coastal region of Bangladesh.

Keywords: Hydrochemistry, evaporite, environmental geophysics, coastal aquifers.

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