Saltwater Intrusion Vulnerability of a Coastal Aquifer along the Bay of Bengal, India

P. PRUSTY[1]* AND S. H. FAROOQ[1]

[1]School of Earth, Ocean and Climate Sciences, Indian Institute of Technology Bhubaneswar, Odisha-752050, India (*correspondence: pp25@iitbbs.ac.in)

Majority of the coastal aquifers across the globe are contaminated by saltwater intrusion and face freshwater crisis. A study has been conducted to access the effect of saltwater intrusion on water quality and identify the dominant coastal processes controlling the groundwater chemistry in a coastal aquifer adjacent to the Bay of Bengal. Multivariate statistical analysis, ionic ratios, and water quality indices were utilized to identify the geochemical processes and delineate the areas with different water quality. Sixty groundwater and nine surface water samples were collected and analyzed for fourteen water quality parameters including major and trace elements. Plotting of major ionic composition in Piper and Chadha's diagrams indicate that Na-Cl (65%) and Ca-HCO_3 (16%) are the main water types in the area. Higher Cl/HCO_3 and Mg/Ca ratios in most of the collected water samples (65%) hint predominant influence of seawater on water quality. However, ion exchange process has been the main factor in determining the water quality in a few samples.

Hierarchical cluster analysis has grouped all water samples into three clusters: (i) saline water cluster, (ii) freshwater cluster, and (iii) cluster of intermediate water type. From the principal component analysis, it is found that the saline water is associated with most of the physico-chemical parameters. Freshwater shows strong association with Mn, Ba, and pH, while intermediate water with NO_3, Fe, and HCO_3. With regard to the usability of water, surface water samples are found to be unsuitable for drinking and mostly unusable for irrigation purpose due to their higher ionic concentrations. The groundwater samples falling in saline water cluster show higher water quality indices and are categorized as poor to unsuitable for drinking. However, the freshwater samples are good to excellent water type and can be used for any purposes. The intermediate water is found suitable for irrigation and may require treatment prior to its drinking usage. Only 32% of groundwater is found to be suitable for direct drinking usage, while 28-42% can be used for irrigation purpose. Awareness regarding appropriate usages of water based on its quality may provide an effective tool in managing the coastal water resources.