

Agricultural Impact on Groundwater in Sandy Aquifers of the Kalpitiya Peninsula, Sri Lanka

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Groundwater in shallow sandy aquifers in the Kalpitiya Peninsula is an essential resource since no other freshwater sources are available in this peninsular. In order to delineate the influence of agricultural activities on the groundwater quality in the region, a comprehensive hydro geochemical study was carried out to investigate the processes that affect the groundwater quality in the region. Major and trace element content in 43 groundwater samples were measured along with $\delta^{18}\text{O}$, $\delta^2\text{H}$ and $\delta^{13}\text{C}$ signatures. Anions of samples were measured using ion chromatography while cations were quantified by ICP-MS. Water isotopes of $\delta^{18}\text{O}$ and $\delta^2\text{H}$ were determined using cavity ring down laser spectrometer while $\delta^{13}\text{C}$ was quantified by isotope ratio mass spectrometer. The groundwater in the peninsula was dominated by Na^+ , K^+ , Ca^{2+} , Mg^{2+} , NO_3^- , HCO_3^- , Cl^- and SO_4^{2-} . Nitrate-N concentrations recorded up to 186 mg/L, which is well above the WHO recommended limits. It provided evidences for anthropogenic inputs of solutes, most likely from agriculture activities. Among the toxic trace elements, As and Se levels in groundwater were also higher compared to that of the dry zone metamorphic aquifers in Sri Lanka, possibly due to influence of the marine sprays. Except in few wells, saltwater intrusion was not significant. Irrigation return flows and their associated evaporation enriched the solute contents in the aquifer. This was confirmed by the stable isotope composition of groundwater that deviated from the local meteoric water line (LMWL) and formed its regression line denoted as the local evaporation line (LEL). The LMWL can be described by $\delta^2\text{H} = 5.51 * \delta^{18}\text{O} - 3.08$. The corresponding $\delta^{13}\text{C}_{\text{DIC}}$ values varied from -13.8% to -8.0% . These isotopes are more typical for carbonate dissolution and equilibration of CO_2 in the aquifer. This study showed that the underlying carbonate system might buffer the aqueous geochemistry of the groundwater in the peninsula. The results of this study indicate that integrated water management is essential and water resources should critically monitor the Kalpitiya Peninsula in order to avoid over-exploitation and seawater inflows.

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