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Impact of Climate Change on Water Resources - the case of Coastal Basin South-Eastern Tanzania

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Prolonged droughts and deforestation have adversely affected the runoff characteristics within the river basin in the southeast costal Tanzania. The combination of insufficient water quantity and deteriorating water quality has triggered the Dar es Salaam water supply authority to begin searching for a groundwater resource to augment surface water as a source of public water supply. In this paper, we discussed the consequences of climate change impact on water resources and identify the major factors affecting the groundwater quality by means of multivariate statistical analyses, using chemical tracers and stable isotope signatures. The results from hierarchical cluster analyses show that the groundwater in the study area may be classified into four groups. A factor analysis indicates that groundwater composition is mainly affected by three processes, accounting for 80.6% of the total data variance: seawater intrusion, dilution of groundwater by recharge, and sewage infiltration. The hydrochemical facies of shallow groundwater was mostly of the Na–Ca–Cl type, although other water types were also observed. The deep groundwater samples were slightly to moderately mineralized and they were of the $NaHCO_3$ type. This water type is induced mainly by dissolution of carbonate minerals and modified by ion exchange reactions. The signal from the stable isotope composition of the groundwater samples corresponded well with the major chemical characteristics. In the shallow groundwater, both high-nitrate and high-chloride concentrations were associated with localized stable isotope enrichments which offset the meteoric isotopic signature. This is inferred to be due to the contamination by influx of sewage, as well as intrusion by seawater. The depleted stable isotope values, which coincides with a chemical signature for the deep aquifer indicates that this deep groundwater is derived from infiltration in the recharge zone followed by slow lateral percolation. This study shows that a conceptual hydrogeochemical interpretation of the results from multivariate statistical analysis (using HCA and FA) on water chemistry, including isotopic data, provides a powerful tool for classifying the sources of groundwater and identifying the significant factors governing the groundwater quality. The derived knowledge generated by this study constitutes a conceptual framework for investigating groundwater characteristics. This is a prerequisite for developing a sound management plan, which is a requirement for ensuring a sustainable exploitation of the deep aquifer water resource in the coastal area of Tanzania.