Water Quality Assessment in the Pangani River Basin, Tanzania: Natural and Anthropogenic Influences on the Concentrations of Nutrients and Inorganic Ions

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Abstract
The ongoing rapid expansions of human activities and population dynamics have a potential impact on the environmental quality of the Pangani River basin, one of the largest water resources in Tanzania, including possible loadings of different kinds of micro-contaminants. However, the specific extent of the impacts is not well investigated. In this work, we assessed the environmental quality of the basin, based on the seasonal characterization of physicochemical water and sediment parameters, dissolved inorganic ions and nutrient loads. The contributions of geochemical processes and land-use practices were evaluated by multivariate correlations and principal component analysis (PCA). Hierarchical cluster analysis was used to classify similar water quality stations and identify the most and least enriched ones. Surface waters were slightly alkaline, characterized by low total dissolved solids (48–652 mg/L). Extremely low oxygen concentration (2.0 mg/L) was also a cause of concern at one station. The Na^+ and HCO_3^- ions provided the dominant cation and anion, respectively. The PCA identified the weathering of carbonate- and Na^+-bearing rocks, gypsum dissolution and atmospheric deposition of sea salt as the major factors controlling the ionic composition, contributing more than 60% of the spatial variance. The concentration profiles of the chemical species showed a generally low level of anthropogenic inputs, except at a few locations where nitrate and nitrite were significantly enriched above the limits of safe exposure, with patterns indicating influences of farming and livestock-keeping. A seasonal difference was observed, with lower ion concentrations during the rainy season, likely due to the dilution effect of increased water discharge. This study provides new insights into the environmental quality of the basin and indicates the need for continuous monitoring and assessment of the chemical species in the area.

Keywords
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Sediment quality,
Dissolved ionic species,
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Pangani River basin,
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