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Assessment of Physicochemical Profile and Heavy Metal Constituents in the Groundwaters of Rural Areas in Southwest Tanzania

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Abstract

This study focuses on groundwater quality in rural areas of Tanzania, addressing the literature gap on water quality data for sustainable rural development. Most rural communities in sub-Saharan Africa depend on groundwater for their domestic use. Despite this importance of groundwater for rural community development, limited research has been conducted on the physicochemical and heavy metal content, creating a significant knowledge gap. The absence of such information raises concerns about water quality in rural areas of Africa, posing potential challenges to public health and community well-being due to the risk of groundwater contamination. To bridge this gap, a comprehensive study was conducted to assess groundwater quality in a selected district, focussing on physicochemical and heavy metal content in 19 boreholes across various villages. The Water Quality Index (WQI) and Principal Component Analysis (PCA) were employed for providing a detailed evaluation of groundwater quality. Results revealed a widespread acidity, iron, and manganese in most boreholes, with 6 exceeding the World Health Organization (WHO) and Tanzania Bureau standards (TBS) for Pb in rainy and dry seasons. Additionally, total dissolved solids, chloride, and hardness surpassed WHO and TBS limits in a single borehole. One-way ANOVA and paired t-tests confirmed significant differences ($p < 0.01$) among boreholes and across seasons. Pearson's correlation test found strongly significant dependences between pH and iron, as well as hardness and manganese. Approximately 73.68% of water samples were classified as poor and polluted water, rendering them unsuitable for drinking. Elevated heavy metals could be attributed to the region's geological features and mining activities. The study underscores the need for pragmatic monitoring and treatment measures to address identified issues and ensure safe drinking water for the community.

Keywords

Borehole, Drinking water, Groundwater, Heavy metals, Physicochemical properties