Integrated Analysis of Groundwater Dynamics in Udupi District, Karnataka, India: A Decadal Examination of Availability, Quality, and Recharge.

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Groundwater, a critical resource for domestic, agricultural, and industrial needs in Udupi district, Karnataka, India, is subject to diverse influences including rainfall, land use, geology, and human activities. This study employs hydrogeological, hydrochemical, and statistical methodologies to analyze groundwater dynamics in the 3,575 km² Udupi district, encompassing four major aquifer systems: alluvium, laterite, crystalline, and coastal. Utilizing groundwater level data from CGWB spanning 2008 to 2018, we conducted trend tests and correlation analyses. Groundwater quality was assessed through geospatial and multivariate analyses. Results demonstrated spatial and temporal variations in groundwater availability and recharge, with coastal unconfined and laterite aquifers exhibiting the highest levels. Generally good groundwater quality prevailed, though localized challenges of salinity, fluoride, and nitrate were identified. Factors influencing groundwater dynamics, such as rainfall, evapotranspiration, land use, pumping, and seawater intrusion, were delineated. Recommendations for enhanced groundwater management and conservation, including rainwater harvesting, artificial recharge, water use efficiency, and systematic monitoring, are provided. The findings shed light on the persistent water scarcity issues during dry seasons in Udupi district, despite its high coastal rainfall, advocating for proactive measures like groundwater banking to address this challenge.