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GROUNDWATER QUALITY AND HUMAN HEALTH RISK FROM NITRATE POLLUTION IN THE UPPER AQUIFER OF YOGYAKARTA-SLEMAN GROUNDWATER BASIN, INDONESIA

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Abstract

Groundwater quality degradation due to anthropogenic factors is a crucial issue faced by most urbanized areas in Indonesia, including the Yogyakarta-Sleman Groundwater Basin. However, the evaluation of groundwater quality on a regional scale is still not completely understood due to the intricate interactions among geological, hydrological, and anthropogenic variables. To address this problem, an integrated approach combining the Water Quality Index (WQI), Nitrate Pollution Index (NPI), and human health risk assessment of nitrate (NO_3) pollution was employed. Sixty groundwater samples were collected from the upper aquifer system during rainy and dry seasons to analyze eleven physicochemical parameters. The WQI results revealed varied groundwater quality classifications in the study area, with 23.33% and 30% of samples categorized as excellent, 70% and 63.33% as good, and 6.67% as poor during the rainy and dry seasons, respectively. This study also highlights NO_3 pollution and its impact on human health risks. NO_3 concentrations ranged from 0.07-85.96 mg/L (mean 19.49 mg/L) in the rainy season and 0.04-65.20 mg/L (mean 17.93 mg/L) in the dry season, with 13.33% of samples in both seasons exceeding the safe limit. Elevated NPI levels were primarily found in urban areas, caused by contamination from unproper septic tanks and on-site sanitation systems. The hazard quotient (HQ) of NO_3 revealed that infants and children have a greater risk of non-carcinogenic health effects from oral ingestion than adults. The findings of this study bridge the gap between water quality assessment and public health implications to advanced our understanding of sustainable groundwater management.

Key words: anthropogenic contamination, human health risk, nitrate pollution, Water Quality Index

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