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Water quality dynamics in Anuradhapura, Sri Lanka: A comparative study from selected springs, wells, canals, and irrigation tanks

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Most of the residents in Anuradhapura consume untreated water from surface and groundwater sources, raising concerns about potential health risks. The water quality was assessed in major irrigation tank cascade system (*Kalawewa, Rajanganaya, Nachchaduwa, Nuwarawewa, and Tissawewa*) Anuradhapura and interconnected canals, wells, and springs. The objective of the study was to assess the quality of surface and groundwater, considering seasonal variations, and to identify potential contaminants that could contribute to health risks and irrigation purposes in the region. Water samples were collected from 78 locations in the wet season (December–February) and the dry season (June–July) in 2023 separately. Both in-situ [temperature, pH, electrical conductivity (EC), dissolved oxygen (DO), total dissolved solids (TDS),] and laboratory analysis [fluoride, chloride, bromide, nitrate, phosphate, sulfate, magnesium, Ca hardness, alkalinity, salinity, total suspended solids (TSS), turbidity, copper, zinc, chromium, and iron] were carried out using the APHA standard method (2017). The results of the physicochemical parameters were statistically tested using two sample t-test to identify seasonal change and one sample t-test to compare with drinking water quality standards WHO (fourth edition) and irrigation water quality standards (CEA 2019). The levels of temperature, EC, fluoride, bromide, chloride, TSS, and magnesium in surface water in the tanks were significantly higher in the dry season compared to the wet season ($p < 0.05$). The level of chromium (wet: 0.30 ± 0.04 mg/l, dry: 0.77 ± 0.06 mg/l) and turbidity (wet: 7.39 ± 0.94 NTU, dry: 6.86 ± 1.14 NTU) in the tank water exceeded the WHO maximum permissible level during the wet and dry seasons ($p < 0.05$). The levels of bromide (wet: 1.06 ± 0.21 mg/l, dry: 18.24 ± 2.78 mg/l) and chromium (wet: 0.03 ± 0.02 mg/l, dry: 0.96 ± 0.014 mg/l) in canals were significantly higher in the dry season compared to the wet season ($p < 0.05$) and exceeded the WHO maximum permissible level in the dry season. The level of calcium hardness (wet: 217.56 ± 36.96 mg/l, dry: 179.13 ± 34.06 mg/l) and chromium (wet: 0.24 ± 0.05 mg/l, dry: 0.18 ± 0.09 mg/l) in wells exceeded the WHO maximum permissible level in both seasons ($p < 0.05$). The fluoride level in wells was significantly high in the dry season (2.59 ± 0.31 mg/l) compared to the wet season (0.94 ± 0.35 mg/l), which exceeded the WHO maximum permissible level in the dry season ($p < 0.05$). The iron level of surface water in irrigation tanks (wet: 2.38 ± 0.95 mg/l) and groundwater (wet: 1.87 ± 0.71 mg/l) in wells in the wet season exceeded the WHO maximum permissible level ($p < 0.05$). All physicochemical parameters of spring water were within permitted levels of WHO standards in both seasons. Groundwater in wells and surface water in tanks and canals situated in this area are not recommended for drinking purposes in both seasons without proper treatment. However, spring water is suitable for drinking purposes throughout the year, and groundwater in the wells and surface water are suitable for irrigation purposes throughout the year.

Keywords: Groundwater, Surface water, Canals, Seasonal, Standards