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Soil quality dynamics in a traditional tank ecosystem: A case study of *Katupotha* tank in Anuradhapura, Sri Lanka

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Traditional tank cascade systems in Sri Lanka play a crucial role in maintaining ecological stability and supporting agricultural productivity, while significantly influencing soil quality dynamics in the dry zone. play a crucial role in soil quality dynamics in the dry zone. Tanks integrate traditional hydraulic engineering and ecosystem-based approaches that support paddy cultivation while influencing soil moisture retention, nutrient cycling, and overall soil health. This study aims to assess the key soil quality parameters, including pH, electrical conductivity (EC), moisture content, bulk density, and soil available macronutrients (nitrate, ammonium, and phosphate) in the surrounding vegetation near *Katupotha* Tank, located in Anuradhapura, Sri Lanka. A total of 30 soil samples were collected from surface (0-15 cm) and sub-surface (15-30 cm) soil layers, and were tested using standard methods. Descriptive statistics indicated surface soil exhibited lower pH (7.23), higher moisture content (25.24%), and lower bulk density (0.79 g cm^{-3}) compared to subsurface soils, which had higher pH (7.63), lower moisture content (18.52%), and higher bulk density (0.96 g cm^{-3}). Electrical conductivity was highly variable across both layers, with a slightly higher value in the surface layer (0.90 µS cm^{-1}). Paired t-test results revealed that several soil parameters differed significantly between surface and subsurface layers. Significant differences were observed in pH ($t = -3.16$, $p = 0.007$), moisture content ($t = 4.98$, $p = 0.001$), bulk density ($t = -2.15$, $p = 0.050$), available nitrate ($t = -2.63$, $p = 0.021$), and available ammonium ($t = 3.98$, $p = 0.001$). These indicate the presence of strong vertical variation in both chemical and physical soil properties. However, no statistically significant differences were found for EC ($t = -0.18$, $p = 0.086$) and available phosphate content ($t = 1.52$, $p = 0.153$). These results highlight the importance of considering soil depth in evaluating soil health, fertility, and nutrient management strategies in the dry zone tank ecosystems.

Keywords: *Nutrient cycling, soil health, soil quality parameters, sustainable land management, tank cascade system*

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