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Evaluation of soil organic carbon content in the tank-associated adjacent environment, Mihintale, Sri Lanka

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The Traditional Tank Cascade Systems (TCSs) in Sri Lanka are centuries-old, nature-based solutions for water management and ecological sustainability in the dry zone. These interconnected tanks, canals, and landscapes support agriculture, regulate water flow, and conserve soil resources. Soil organic carbon (SOC) is a vital terrestrial carbon sink affecting agricultural productivity and climate regulation. This study evaluated SOC dynamics in the environment adjacent to four canal-connected tanks: *Thammennawa*, *Miriskatukeliyawa*, *Katupotha*, and *Mahakirindegama* within a well-functioning tank cascade system in Mihintale, Sri Lanka. Soil samples were collected at two depths: surface (0–15 cm) and sub-surface (15–30 cm) soil layers, and analysed for total organic carbon (TOC), bulk density using standard procedures and SOC stock was calculated. Results showed that surface soils exhibited higher SOC levels, with *Mahakirindegama* site recording the highest mean SOC (177.7 Mg C ha^{-1}), followed *Katupotha* (172.4 Mg C ha^{-1}), *Thammennawa* (133.6 Mg C ha^{-1}), and *Miris Katukeliyawa* (108.5 Mg C ha^{-1}). Subsurface SOC declined, through *Mahakirindegama* (110.4 Mg C ha^{-1}) and *Miris Katukeliyawa* (86.3 Mg C ha^{-1}) maintained relatively higher values compared to *Thammennawa* (77.64 Mg C ha^{-1}) and *Katupotha* (60.10 Mg C ha^{-1}). Higher SOC at some sites resulted from increased organic inputs and microbial activity. Paired t-test analysis revealed statistically significant SOC differences between surface and sub-surface depths in *Thammennawa* ($t = 5.03$, $p < 0.001$), *Katupotha* ($t = 4.52$, $p < 0.001$), and *Mahakirindegama* ($t = 3.02$, $p = 0.009$), indicating greater surface soil SOC retention, could be increased organic matter accumulation and enhanced microbial activity. In contrast, *Miris Katukeliyawa* showed no significant difference ($t = 1.19$, $p = 0.252$), suggesting a more uniform SOC distribution. Spatial variability in SOC content reflected the influence of hydrological connectivity, sedimentation, and land use. These results underscore the role of tank associated landscapes in enhancing soil carbon storage and emphasize the depth-dependent nature of SOC in supporting sustainable land management in traditional TCSs.

Keywords: *Carbon sequestration, organic matter accumulation, soil health, sustainable land management, tank cascade system.*