WAT-44 ORAL PRESENTATION · WATER TRACK · HYDROGEOCHEMICAL PATHWAYS FOR SUSTAINABLE INFRASTRUCTURE

Assessment of Trace Metal Distribution and Drinking Water Suitability of Dug Wells across Urban, Suburban and Rural Areas in Batticaloa District, Sri Lanka

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DOI: https://doi.org/10.31705/ICEWSE.2026.38

Abstract

Dug wells serve as a primary drinking water source in Batticaloa, where increasing anthropogenic activities may influence groundwater quality. This study assessed trace metal distribution along with physicochemical and microbiological parameters from 18 dug wells across urban (W_1–W_6), suburban (W_7–W_{12}) and rural (W_{13}–W_{18}) areas to evaluate their suitability for drinking. A total of 12 sampling rounds were conducted, yielding 432 samples which were collected at two-week intervals between February and August 2025 and analyzed using standard methods, including inductively coupled plasma-optical emission spectrometry (ICP-OES) for elemental analysis and membrane filtration for microbiological assessment. Water quality was evaluated using the Canadian Council of Ministers of the Environment Water Quality Index (CCME-WQI), compared with Sri Lankan (SLS 614:2013) and World Health Organization drinking water standards. Trace metal concentrations exhibited spatial variation, with Ni detected only in urban wells and Cd exclusively in suburban wells, while Pb, Cr, Co, and Be were not detected in any samples. Metal pollution indices, including the Heavy Metal Evaluation Index (HMEI), Heavy Metal Pollution Index (HPI), Degree of Contamination (C_{deg}), and individual Pollution Index (P_i), further confirmed that there is no significant trace metal contamination (HMEI = 0.86–0.94; HPI = 0.85–1.62; C_{deg} = −14.06 to −14.13; P_i = 0–0.37). Significant differences among land-use categories were observed ($p < 0.05$) for Ca (0.00–52.55 ppb), Mg (1591.87–18837.16 ppb), K (0.83–32.50 ppm), Cu (0.00–4.74 ppb), Zn (0–115.13 ppb), Ag (0.00–2.44 ppb), and Li (0.55–15.12 ppb), indicating the spatial variability in distribution of trace metals. However, all detected trace metals remained well below drinking water permissible limits. Microbiological contamination was widespread, with total coliforms and *Escherichia coli* detected in all wells except W_{18}. The CCME-WQI classified water quality ranging from excellent (W_{14}) to fair (W_2), with rural wells scoring comparatively better overall water quality (WQI > 80). Although trace metal contamination was not a concern, the widespread coliform contamination indicates that dug well water is unsuitable for direct consumption without appropriate treatment. Continuous monitoring, improved sanitation practices, and proper household water treatment are therefore recommended to ensure drinking water safety in Batticaloa District.

Keywords: *coliform; dug well; trace metal; water; water quality index*