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REVERSE OSMOSIS TREATMENT AND ENVIRONMENTAL RISK IN A CKDu HOTSPOT: A CASE STUDY FROM WILGAMUWA, SRI LANKA

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Chronic Kidney Disease of uncertain etiology (CKDu) is a major public health concern in Sri Lanka, particularly in the dry zone. The most widely supported hypothesis associates CKDu with drinking-water quality, with hydrogeochemical factors. Although reverse osmosis (RO) treatment plants have been installed to improve water quality in affected regions, they produce highly concentrated effluents that are often discharged untreated, posing ecological risks. This study evaluated key geochemical parameters in source water, treated (filtered) water, and effluent water from selected RO plants (n = 10) in Wilgamuwa, a high CKDu-prevalent area. Most source water samples were moderate to very hard, with total hardness (TH) ranging from 80 – 340 mg L^{-1}. The mean total alkalinity (TA) was 196 mg L^{-1}, which is close to the maximum permissible limit specified by the Sri Lanka Standards (SLS). Two source water samples exceeded the fluoride guideline of 1.0 mg L^{-1}. The average ion removal rates from source water across the RO treatment plants were 88% (Mg^{2+}), 77% (Ca^{2+}), 64% (K^{+}), 34% (Na^{+}), 79% (F^{-}), 84% (Cl^{-}), and 95% (SO_4^{2-}). The filtered water showed TA of (3 – 7 mg L^{-1}) and TH of (4 – 36 mg L^{-1}). Ion concentrations in filtered water samples were: Ca^{2+} (3 – 9 mg L^{-1}), Mg^{2+} (< 2 mg L^{-1}), Na^{+} (3 – 14 mg L^{-1}), K^{+} (< 5 mg L^{-1}), F^{-} (1 mg L^{-1}), Cl^{-} (8 mg L^{-1}), and SO_4^{2-} (< 2 mg L^{-1}). In contrast, effluent water showed considerable variability, with TA ranging from 115 – 708 mg L^{-1} and TH from 96 – 720 mg L^{-1}. Electrical conductivity and total dissolved solids in the effluent ranged from 444 – 1776 µS cm^{-1} and 284 – 1243 mg L^{-1}, respectively. Effluent ion concentrations were: Ca^{2+} (19 – 80 mg L^{-1}), Mg^{2+} (2 – 34 mg L^{-1}), Na^{+} (10 – 149 mg L^{-1}), K^{+} (1 – 5 mg L^{-1}), F^{-} (< 3 mg L^{-1}), Cl^{-} (4 – 250 mg L^{-1}), and SO_4^{2-} (9 – 104 mg L^{-1}). This highly concentrated RO effluent is often discharged directly into agricultural land or nearby waterways, raising concern about soil salinisation and water quality degradation. These findings emphasise the need for effective RO effluent treatment, using methods such as chemical precipitation or electrodialysis, before environmental release. Future research should assess trace metals in RO effluents to evaluate their roles in contamination of surface and groundwater, and bioaccumulation in aquatic food webs.

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