

TRACING WATER DYNAMICS IN *MALWATHU OYA* CASCADE-I USING STABLE ISOTOPES

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Sri Lanka is an island with a monsoonal-dominated tropical climate that faces climate-induced water scarcity, posing significant challenges in water management in the dry zone. The use of isotopic tracers in water management studies has grown in popularity due to their role as natural tracers, highlighting essential insights about water sources, pathways, and movement, especially in regions susceptible to climate change. This study explored water dynamics within the *Malwathu Oya* cascade-I in Sri Lanka, focusing on the application of stable isotopes, specifically oxygen-18 ($\delta^{18}\text{O}$) and deuterium ($\delta^2\text{H}$) to trace water sources, movement, and interaction during the December to May period in 2023/2024. The stable isotope composition of various water sources, including rainwater, surface water, shallow groundwater, and deep groundwater was analyzed using a two-component mixing model to understand their contribution to the Tank Cascade System (TCS). The relationship between the isotope signature and the Global Meteoric Water Line (GMWL) was analyzed, and the deuterium excess (d-excess) was used to indicate vapor source conditions. There is a strong correlation between $\delta^{18}\text{O}$ and $\delta^2\text{H}$ (about 0.9), suggesting that similar hydrological processes influence both isotopes. The findings align with the GMWL, confirming that precipitation is the main source of TCS waters (average about 82%). This study highlights the importance of isotopic data in identifying reliable water sources, understanding water quality, and developing strategies for sustainable water management. The findings of this research provide critical insights for improving water use efficiency and ensuring the sustainability of ancient irrigation systems in response to changing environmental conditions.

Keywords: Global meteoric water line, Stable isotopes, Tank cascade system, Water quality