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Assessing Sustainability of the Lunugamwehera Reservoir in Sri Lanka

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Abstract

Growing water demand driven by population growth and agricultural expansion has increased concerns regarding the sustainable management of water resources. This study assesses the sustainability of the Lunugamwehera Reservoir in southern Sri Lanka, a major source of irrigation water for the region. HEC-HMS and an annual water balance (AWB) approach were used to estimate reservoir inflows, and assess storage variations during 2012–2023. Six sustainability indicators - annual water balance (AWB), storage variation (SV), spill efficiency (SE), domestic water demand satisfaction (DWDS), reservoir utilization (RU), and irrigation water demand satisfaction (IWDS) - were assigned relative weights using the Criteria Importance Through Intercriteria Correlation (CRITIC) method. The resulting weights were 0.202, 0.187, 0.186, 0.151, 0.150, and 0.124, respectively. The Sustainability Index (SI) was calculated annually using an additive aggregation approach and classified into five equal intervals within the 0.00–1.00 range, representing very poor, poor, moderate, good, and excellent sustainability levels. The results revealed considerable temporal variation in reservoir sustainability, with the highest SI recorded in 2012 (0.589), followed by declines to 0.379 in 2016 and 0.278 in 2020. Overall, the reservoir exhibited moderate sustainability during the study period, with SI ranging from poor to moderate sustainability. AWB, SV, and SE received the highest relative weights, indicating their greater contribution to the sustainability assessment. The findings highlight the importance of water balance, storage dynamics, and spill performance in reservoir management and provide a quantitative framework for assessing sustainability and evaluating management strategies.

Keywords: *annual water balance (AWB); inter-basin water transfer (IBWT); Kirindi Oya; optimized model parameters; Thanamalwila*