ASSESSING SUSTAINABILITY OF WATER RELEASES FROM THE LUNUGAMWEHERA RESERVOIR IN SRI LANKA

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Water security is an increasingly critical concern in many regions across the globe. This is due to the rising demand for freshwater, driven by population growth, climate change, and agricultural expansion. Sri Lanka, particularly its dry zone, faces significant water scarcity issues. In these regions, water availability varies greatly. Reservoirs play a vital role in storing and regulating water for irrigation, domestic supply, and hydropower. However, the sustainability of these reservoirs' water releases is under threat. This study seeks to assess the sustainability of water released from the Lunugamwehera reservoir in Southern Sri Lanka. The reservoir, which was established in 1986, caters for the needs of over 5,200 families in the area. The agricultural sector is the largest consumer of water, particularly for paddy cultivation. Ensuring that water releases from reservoirs such as Lunugamwehera are aligned with the demand is essential, and increasingly a matter of concern. This is crucial for safeguarding agricultural productivity, public health, and ecological balance.

The study evaluates the Lunugamwehera reservoir's ability to meet its water demands amidst these challenges. The Hydrologic Engineering Center's Hydrologic Modelling System (HEC-HMS) is used to simulate runoff and estimate inflows to the reservoir. It uses daily rainfall and streamflow data from 2012 to 2023. A water balance approach is then employed to assess the relationship between water inflows, outflows, and storage variations within the reservoir. To evaluate the sustainability of water releases from the reservoir, several indicators were selected. These include annual water balance (AWB), storage variation (SV), irrigation water demand satisfaction (IWDS), domestic water demand satisfaction (DWDS), spill efficiency (SE), and reservoir utilisation (RU). These indicators were normalised and then weighted using the CRiteria Importance Through Inter-criteria Correlation (CRITIC) method. The resulting Sustainability Index (SI) is calculated through the additive aggregation method. This method combines the weighted values of the indicators to produce an overall measure of sustainability for each year from 2012 to 2023.

The results of this study reveal significant fluctuations in the sustainability of the Lunugamwehera reservoir over the years. SI showed the highest value in 2012. However, subsequent years experienced declines, particularly from 2016 to 2020. However, slight improvements in sustainability were observed in the later years. This research contributes valuable insights into the water management practices of Sri Lanka's reservoirs. The study's findings highlight the need for improved water management strategies. This can help policymakers and water resource managers make informed decisions for ensuring long-term water security.

Keywords: Inflow Generation, Inter-basin Water Transfers, Sustainability Indicators, Weheragala

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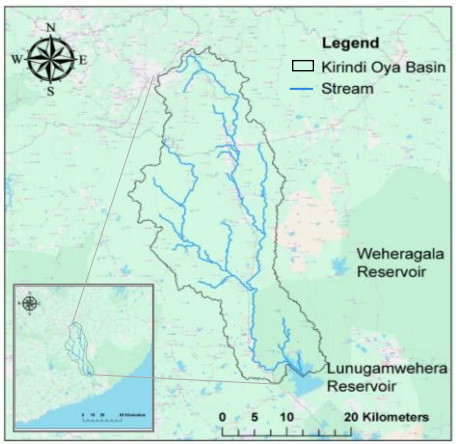
Lunugamwehera Reservoir

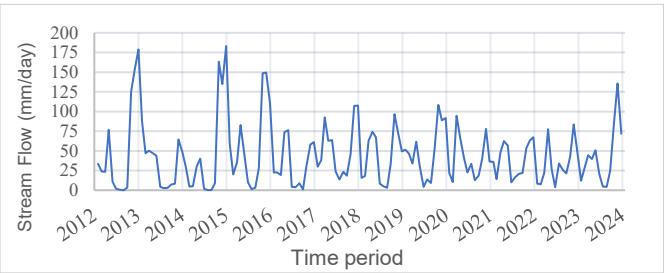
Sri Lanka



Reservoir Inflow

Kirindi Oya Inflow
- HEC-HMS
- ArcGIS

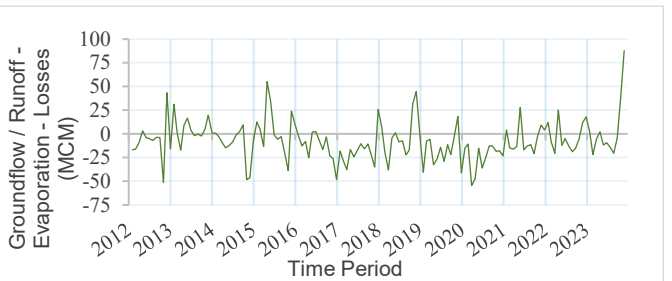
Weheragala Inflow
(Menik Ganga Diversion to Lunugamwehera)



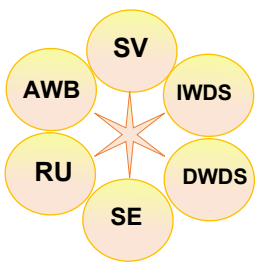
Water Balance Study

$\Delta S = (P + I) - (E + C + Sp)$

ΔS - Storage Variation
P - Precipitation
I - Inflow
E - Evaporation
C - Canal Discharge
Sp - Spill

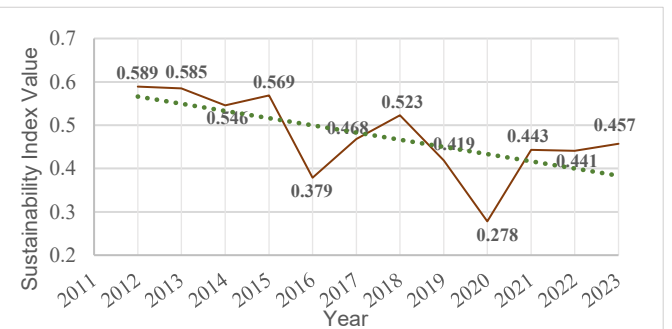


Sustainability Indicators



Sustainability Assessment

- Min-Max Normalizing
- CRITIC Weighting
- Additive Aggregating



Moderate Sustainability : Need for adaptive water management to ensure future agricultural water security