EVALUATING THE IMPACT OF TRANS-BASIN WATER TRANSFER ON WATER SECURITY IN SRI LANKA: A CASE STUDY OF THE HURULUWEWA CATCHMENT, SRI LANKA

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Many river basins are becoming increasingly vulnerable to extreme fluctuations both in high and low flows due to climate change. Trans-basin water transfers offer a sustainable solution by redistributing surplus water to areas with shortages, helping balance uneven distribution. This study assesses the water balance in the Huruluwewa catchment (with an area extent of 183.1 km^2), located in the North Central dry zone of Sri Lanka. It aims to identify periods of water stress and surplus while exploring trans-basin management strategies for improved water resource management.

To estimate daily inflow to the Huruluwewa reservoir, 30 years of precipitation data were analyzed to establish long-term climate trends. The HEC-HMS (Hydrologic Engineering Center's Hydrologic Modeling System) model was employed for rainfall-runoff modelling. The catchment was divided into two sub-basins at the model development to enhance model accuracy. The calibrated model demonstrated satisfactory performance, as evidenced by favourable Nash-Sutcliffe, RMSE, R^2, and percent bias values. Flow Duration Curves (FDC) were utilized to verify and further refine the model simulations.

To assess the impact of climate change on streamflow for the near future (2030-2049), projected precipitation and temperature data from the CNRM-CM6-1-HR model were used under two SSP (Shared Socioeconomic Pathways) scenarios. The LARS WG (Long Ashton Research Station Weather Generator) software was utilized to downscale the climate data. The SSP1-2.6 scenario predicts a 6.4% increase in total annual rainfall while the SSP5-8.5 scenario forecasts a 5.5% increase. Projected future precipitation data indicates increased monsoonal rainfall in the study area. During the Southwest Monsoon, precipitation is expected to rise by 17.2% under SSP1-2.6 and 14.68% under SSP5-8.5. For the Northeast Monsoon, increases are 8.77% and 8.57%, respectively. Future average temperature is projected to rise significantly, with an increase of 1°C each month compared to the base period under the SSP5-8.5 scenario. This temperature rise will lead to higher evaporation rates.

The current water demand for paddy cultivation in the Maha and Yala seasons is 1,270 mm and 1,327 mm, respectively. However, future demand is expected to rise due to increased evapotranspiration from higher temperatures. Based on the estimated analysis results, it has been determined that the water availability in the Huruluwewa catchment is insufficient to meet the irrigation water requirements. An additional 20.7 MCM (Million Cubic Meters) of water is required to cultivate the entire command area under the reservoir. However, this water deficit had reduced to 4.2 MCM due to the potential of trans-basin water transfer. Furthermore, the current water deficit is projected to escalate to 24.7 MCM and 29.4 MCM under the anticipated climate scenarios (SSP1-2.6 and SSP5-8.5, respectively) for the period spanning 2030 to 2049 and it is imperative to implement proactive water management strategies to ensure sustainable water management in the region.

Keywords: Climate change, Monsoonal precipitation, Rainfall-runoff Modelling, reservoir water balance, Trans-basin water transfer

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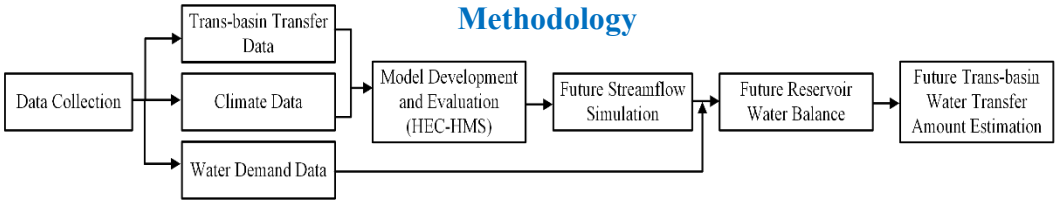
Aim

To assess the water balance and identify potential water stress and surplus periods within the Huruluwewa catchment situated in the North Central dry zone of Sri Lanka which is frequently subjected to water scarcity while focusing on trans-basin water management.

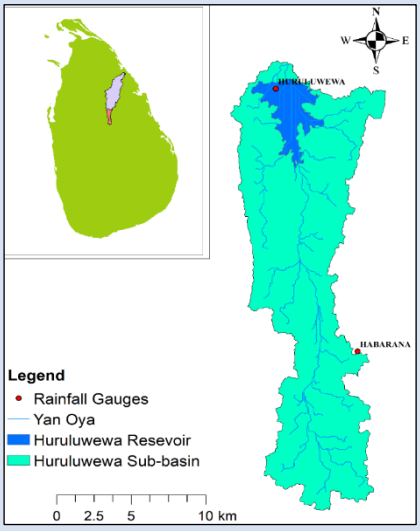
Specific Objectives

- To assess the current and future water availability.
- To assess the water demand in the selected catchment.
- To identify potential water stress/surplus periods.
- To assess the effect of trans-basin water transfer on the selected catchment

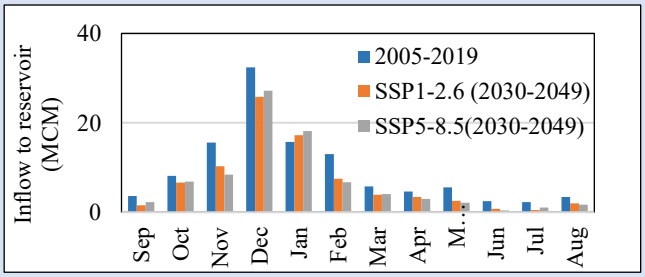
Methodology



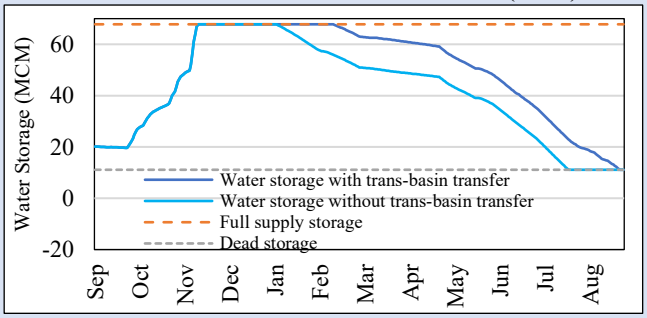
Results and Conclusion



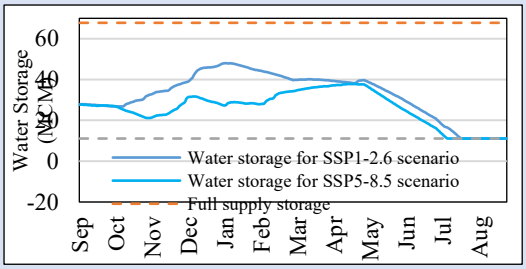
Study Area – Huruluwewa Catchment



Current and Future Inflow to Reservoir (MCM)



Current Reservoir Storage Variation



Future Reservoir Storage Variation

Current Water Deficit Without Trans-basin Transfer – 20.7 MCM

Current Water Deficit With Trans-basin Transfer – 4.2 MCM

Required Future Trans-basin Water Transfer Under SSP1-2.6 Scenario – 24.7 MCM

Required Future Trans-basin Water Transfer