ABSTRACT

Water management has been a challenging task in the *Hakwatuna Oya* irrigation system in Kurunegala district due to water scarcity which lead to lower crop productivity and increase conflicts. The average extent cultivated during last five years in *Yala* season was only 46% whilst it was 87% in *Maha* season. Frequent crop failures and abandoning of cultivation seasons are reported in the recent past due to inadequate water supply. Among the major irrigation schemes in Kurunegala district, this scheme has lowest water duty in *Yala* season. In addition, the *Hakwatuna Oya* is an ungauged catchment where assessment of available water resource is another added problem for the water managers.

Prediction of available water at catchment scale has become vital, for decision makers to develop appropriate management plan for managing water resources in a sustainable way. Further, assessment of catchment level water demand assist managers in making decision at present and to formulate appropriate management strategies for future in the context of changing climate. In order to achieve such objectives, water resource models play a vital role to understand complex systems and provide useful information to the managers and policy makers for planning. In the above context, present study was aimed to apply hydrological and water resources management models to develop appropriate management strategies to allocate water among different users in the *Hakwatuna Oya* irrigation scheme.

HEC-HMS and WEAP as catchment hydrological models were applied to simulate stream flow from ungauged *Hakwatuna Oya* catchment. Since it is an ungauged catchment, hydrological data collected from a hydrologically similar gauged catchment (*Tittawella* tank) were used for model calibration and validation. Calibrated models were used to simulate flow from *Hakwatuna Oya* catchment by adopting area ratio technique. Irrigation water requirement (IWR) of paddy for the periods 2025s (2011-2040) and 2050s (2041-2070) under A2 and B2 emission scenarios were estimated and compared with the baseline (1971-2000). WEAP was applied to evaluate different management scenarios on water resource and supply deficit. Three main scenarios were built from reference scenario; Crop change, irrigation efficiency plus crop change and water import. Sub-scenarios were built for each main scenario to assess various management options on adequacy of water supply.

The results showed that HEC-HMS and WEAP models adequately simulate runoff from *Hakwatuna Oya* catchment. HEC-HMS enables runoff simulation on daily basis with better prediction of peaks, necessary for flood forecasting, compared to WEAP. Since monthly simulation is adequate for water managers to take management decisions, WEAP as a single model can be used for both runoff simulation and taking management decisions in *Hakwatuna Oya* catchment.

Water requirement of 3½ months paddy in *Maha* season was found to be 1,282 mm whereas it was 1,381 mm in *Yala* season. The crop water requirement, which depends primarily on temperature, remains relatively stable over the simulation period up to

2070. When compared to baseline, the rainfall is expected to increase by 32% and 27% from 2041 to 2070 under A2 and B2 scenarios, respectively. As a result, the total water availability from rainfall and irrigation water issues from *Hakwatuna Oya* reservoir in *Maha* season would increase in the future with an overall water deficit to reduce from 28% to 18% and from 28% to 20% under A2 and B2 scenarios, respectively. For *Yala* season, this reduction was found to be 30% to 24% and 30% to 26% under A2 and B2 scenarios, respectively. Further, additional benefits of climate change can be achieved through an effective use of enhanced rainfall particularly in the months of January and August by adjusting planting time.

Results of scenario analysis showed that under the average flow condition, nearly 32 MCM of additional water supply is required to satisfy the needs of all water use sectors in this system. Cultivation of OFC in *Yala* season, increasing irrigation efficiency of OFC cultivation and water diversion are the possible management options to reduce unmet demand in this system. Diversion of 5 MCM water along with 100% OFC cultivation or 10 MCM water diversion along with 75% OFC cultivation is adequate to meet seasonal water demand of agricultural sector while ensuring the domestic water supply at the rate of 80 liters per person per day, 10% of average annual flow for environment and 2% of average annual flow for industrial use under changing hydrological flow in this system.