## ABSTRACT

Quantifying the impact of climate change on both hydrological processes and water resources is challenging as well as crucial for managing water resources optimally. This study focused on the assessment of the performance of the Kangsabati irrigation project under the historical and climate change scenarios using Integrated Reservoir based Canal Irrigation Model (IRCIM). Kangsabati irrigation project is a major irrigation project in the state of West Bengal, India, having catchment and command areas of 3428 and 5568 sq km, respectively. Historical data pertaining to hydrometeorology, reservoir characteristics, and releases, and land use/land cover (LU/LC) of different years were collected from various agencies. General Circulation Models (GCM's) provide future climate projections at coarse resolution, which need to be downscaled at station scale for impact analysis studies. In this study, four GCMs, with RCP2.6, RCP4.5, and RCP8.5 scenarios, were considered. Bias Correction and Spatial Downscaling (BCSD) was applied to downscale the maximum and minimum temperatures at station scale, whereas Multiple Linear Regression (MLR) was used to downscale rainfall. LU/LC change modelling for near future period was carried out using the Cellular Automata (CA)-Markov model, based on the historical LU/LC changes in the study area. The results showed that barren land, agricultural fallow and settlement would increase to 10.92%, 15.94% and 10.06%, respectively, whereas dense forest would reduce to 8.74% in the year 2025. IRCIM was calibrated and validated for the period 1986-2000 and 2001-2011, respectively, and validated model was used with actual and modified delivery schedules. The performance (adequacy, dependability, equity, and efficiency) of the Kangsabati irrigation project improved under the modified delivery schedules. The downscaled maximum and minimum temperatures showed an increasing trend, and as a result, evaporation loss from reservoir increased from 34 MCM under historical scenario to 41 MCM, 44 MCM and 46 MCM under RCP2.6, RCP4.5 and RCP8.5 scenarios, respectively. Moreover, crop evapotranspiration increased by 17-19% and 16-18% in RCP2.6, 18-20 and 16-19% in RCP4.5, and 18-23% and 16-24% in RCP8.5, for Left Bank Feeder Canal (LBFC) and Right Bank Main Canal (RBMC) commands, respectively. Rainfall increased in all RCP scenarios, except for a few stations under RCP2.6. IRCIM simulated inflow, evaporation, reference crop evapotranspiration, and reservoir releases at LBFC and RBMC head regulators were found to be higher than the historical values for all RCP scenarios. Irrigation water demand and supply were found to be higher under RCP8.5 than under RCP4.5 and RCP2.6 scenarios in near future (2011-2040) and mid future (2041-2070). The analysis showed that the reservoir storage capacity would reduce in future, and so will the storage at the end of kharif season. The combined effect of land use and climate changes indicated that the inflow would increase by 6.88% under RCP2.6, 16.64% under RCP4.5 and 14.67% under the RCP8.5 scenario. These results indicate that both land use and climate changes will intensify hydrological changes and play a dominant role in the hydrology of the Kangsabati reservoir catchment. These results may serve as a guideline for managing the Kangsabati irrigation project in the near future, under changing land use, climatic and reservoir storage conditions.



**Keywords:** Integrated reservoir-based canal irrigation model, climate change, statistical downscaling, projected reservoir characteristic curve, land use change, CA-Markov model, Irrigation system performance