ABSTRACT

Dams have had a profound positive impact on the economy of a country by delivering essential services across multiple sectors—ensuring drinking water supply, meeting irrigation demands, producing hydroelectric power, enabling flood control and management, promoting tourism, and offering various other benefits. To achieve such multi-purpose functions effectively, dams must be operated to optimize water use efficiency. In this context, inflow forecasting plays a critical role in supporting the efficient operation of dams. Inflow forecasts derived from ensemble weather forecasts can provide a range of possible inflow estimates. This approach equips dam authorities with valuable insights—not only for flood preparedness but also for optimal dam operation under uncertainty.

Currently, the Central Water Commission (CWC) primarily relies on statistical correlations between gauge and discharge stations for flood forecasting. Integration of ensemble weather forecasts into hydrological to generate inflow forecast for dams is yet to be implemented operationally by the CWC and State Water Resources Departments, despite significant strides in weather forecasting in India.

This study aims evaluate the accuracy of medium range 12-member ensemble rainfall forecasts from National Centre for Medium Range Weather Forecasting (NCMRWF) in dam inflow forecasting of Rengali dam with 10-day lead. The objective is achieved by developing a complex hydrological model to stimulate runoff generation and routing using HEC-HMS and then integrating the hydrological model with ensemble rainfall forecasts from NCMRWF to compare the performance of this integrated ensemble inflow forecasting system with the existing statistical correlation flood forecasting method for Rengali dam.

The study found that statistical correlations were found to perform satisfactorily for gauge-to-gauge streamflow forecasting, but their effectiveness in predicting inflow to Rengali Dam was limited. Performance of the NCMRWF were found to be satisfactory up to 3-day lead only, without any post-processing of the forecasts. Median of the ensemble member of rainfall forecasts performed better in comparison to individual members. The ensemble inflow forecasts followed the same path as the rainfall forecasts, suggesting that although performance of the hydrological model is crucial, overall accuracy of inflow forecasting models is heavily influenced by the accuracy of the meteorological forecasts. Performance of the integrated hydrological

model was found better than statistical correlations in terms of enhanced sensitivity to meteorological uncertainties, improved forecast reliability and lead times.

Keywords: Rengali dam, inflow forecasting, NCMRWF, HEC-HMS, ensemble forecasts.