Evaluating the efficacy of hydrologically and hydrodynamically driven methods of e-flow assessment for Upper Godavari River Basin, India

*GAURAV KALIDAS PAKHALE[1], Jyoti Punjahari Nale[2], Ashvin Kumar Gosain[3], Rakesh Khosa[3]

1. PhD Research Scholar, Civil Engineering Department, Indian Institute of Technology, Delhi, 2. Project Advisor, IEWP, GIZ India, New Delhi, India, 3. Professor, Civil Engineering Department, Indian Institute of Technology, Delhi

In Peninsular India, pronounced seasonality in the precipitation and tropical semi-arid climate have compelled the tremendous development in the water resources sector. The major proportion of this fertile plateau falls in the rainshadow region of Western Ghats and is rightfully supported through enormous irrigation schemes which include the operation of several large reservoirs. These developments have resulted in alteration of various components of a natural hydrological regime like low as well as high flows. Environmental flows (e-flows), though acknowledged widely for their benefits, have not been attempted vigorously for peninsular river basins due to the prioritised issues related to water scarcity and disputes over water sharing. Also, many of these river streams have historically been known as non-perennial, thus further weakening the case of e-flows. Effectively, many recent e-flow assessments, have been observed to be elementary, quick and based on methods that are less intensive in terms of data and time requirements. In this view, the present study attempts to verify the efficiency of various hydrology and hydrodynamics-based e-flow assessment methods in one of such river basins, Upper Godavari River Basin. For this, hydrological observations of 16 sites with long term record availability (20 years or more) have been used and latest cross section data for these sites have been used for hydrodynamic computations.

Hydrological indices based on concepts like Percentage of Flow (POF) and Range of Variability Approach (RVA) have been estimated using a natural flow regime obtained from SWAT rainfall-runoff modelling. POF approaches like Tennant Method, Tessman Method, Variable Monthly Flow Methods are analysed while RVA approach has been analysed using Indicators of Hydrological Alteration (IHA) platform. These indices have been analysed for their feasibility and acceptability under the natural flow regime to understand the efficacy of these indices in providing optimum e-flow suggestions. Present observed flow regime has been juxtaposed with these indices to assess the present flow health in their comparison.

Hydrodynamic computations have been performed in HEC-RAS using 1-dimensional steady state conditions. Flow discharge versus flow depth, wetted perimeter, etc. relationships obtained for these study sites have been utilised to understand the critical flow levels which ensure the maximum bed inundations preferable for ecological sustainability. Wetted perimeter method of e-flow assessment has been evaluated for its suitability to provide the optimum e-flow suggestions. It has been found that hydrology based simple and quick methods of e-flow assessment fail the basic criteria of feasibility even under natural flow regime while hydrodynamic approach gives site-specific solutions which may not be relatable in longitudinal e-flow implementation.

Keywords: environmental flows, Range of Variability Approach, Wetted perimeter method

