Assessing Environmental Flow in a River Basin of Eastern India

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Ecological integrity of the river systems is sustained by the flow regime maintained in a river system. Severe conflicts among the multiple water users and growing anthropogenic activities in a river basin have resulted in significant human impacts on the natural flow regime, which in turn destroys river ecosystem in many parts of the world. Water management actions for maintaining ecological sustainability usually focus on the quantification of environmental flow (e-flow) to meet the minimum ecological requirement. However, estimating e-flows in modified rivers is difficult, especially under data-scarce conditions. Most of the e-flow assessment methods consider natural flow and require extensive data, which are rarely available in most developing countries including India. This study addresses this issue by using a calibrated hydrological simulation model to generate naturalized streamflow by neglecting the major infrastructures such as reservoirs, canals, irrigation diversions from the river reach. Using the simulated natural flow series, the monthly environmental flow was estimated using the “Flow Duration Curve Shifting” technique for three (‘A’, ‘B’, and ‘C’) environmental flow management classes (EMC) that mimic the pattern of natural flow series. The results of the hydrological simulation indicated that the post-impact flow regime has changed significantly as compared to the natural flow regime. It was found that the mean monthly natural flow varies from about 65 to 300 m3/s, while the mean monthly post-impact streamflow ranges from about 1 to 225 m3/s, with a reduction in the median flow by 13 times. The construction of reservoirs has resulted in reduced streamflow peaks during monsoon seasons. The estimated monthly e-flow series has a maximum value in October and minimum flow in April for all the three EMCs. In order to preserve the river ecological system, approximately 78, 63, and 51% of the mean annual streamflow are estimated as e-flows for the ‘A’, ‘B’, and ‘C’ classes of environmental flow management, respectively. The approach followed in this study can be applied to the data-scarce and human-affected river basins of varying hydro-climatic regions for developing ecological sustainability plans in river systems. Future studies should focus on the estimation of ecological footprints at a basin scale.