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Assessing The Environmental Flow of Major Rivers in The Ganges-Brahmaputra-Meghna Basin

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As the river flow has been decreasing consistently in the Ganges-Brahmaputra-Meghna Basin, the rivers cannot maintain ecological integrity for an extended period. Therefore, a new ecosystem with poor biodiversity develops in these rivers. Maintaining environmental flow (e-flow) is a grave challenge, but its determination is complex because knowledge of hydrology, ecology, and other related disciplines is needed to refine the analysis. In this study, three hydrological methods were used to estimate the e-flow: (i) the Flow Duration Curve method shows the percentage of time that the flow in the river is expected to be equal to or greater than a specific value, (ii) the Mean Annual Flow method determines the e-flow requirement at various percentages (10–200%) of the mean annual flow, and (iii) the Constant Yield method assumes that the e-flow can be established at 100% of the median monthly flow for each month. The daily water level data of 18 major river sections during 1998–2017 were collected from the Bangladesh Water Development Board. The data were analyzed for two split periods, i.e., 1998–2007 and 2008–2017, and categorized into three seasons per year, i.e., low flow, high flow, and intermediate flow seasons. Two extreme (maximum and minimum) river stage values in each year were identified and subject to trend analysis using a statistical model.

Both annual maximum and minimum river stages in most rivers show declining trends, indicating that the sustainability of the ecosystem services is at substantial risk. The yearly maximum water level in 14 rivers showed a significant decreasing trend. The 2008–2017 period had a considerably lower mean monthly water level than the 1998–2007 period for almost all the rivers. These decreasing rates were similar for all the months, suggesting that the water extraction for dry season irrigation is not the only reason. Minor rivers were more affected than large rivers, like the Ganges-Padma and the Brahmaputra-Jamuna Rivers. The weak connectivity between the mainstream and the distributaries (relatively small rivers) does not allow enough water to feed the distributaries at their sources. Another reason is that the small rivers are more exploited than the large ones. Unlike other rivers, the tidal Meghna River has shown higher mean monthly water levels in recent decades, possibly because of climate change-induced sea level rise. Most rivers cannot maintain the same e-flow thresholds in the two subsequent decades (Fig. 1).

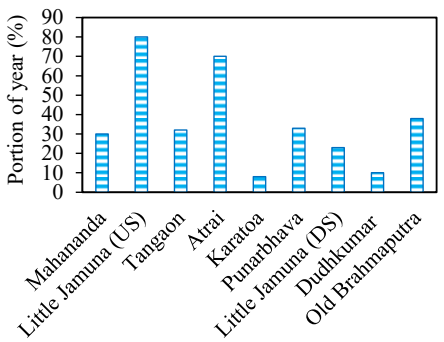

Fig. 1. Portion of year (%) for which rivers cannot maintain environmental flow.

A detailed assessment of the water bodies is needed with the following targets: storing more surface water, rainwater harvesting, maintaining a threshold groundwater level that acts as a buffer for a healthy aquatic ecosystem, re-excavation of channels, regular dredging of small rivers with proper maintenance of the dredged materials, location-specific and ecosystem-based interventions, restoration of dead rivers, controlled extraction during the minimum flow period, and efficient use of water. Watershed-scale plans and the Integrated Water Resources Management approach are needed for the sustainable use of surface water and groundwater. Trans-boundary river management and addressing sea level rise are the issues to be emphasized.