ABSTRACT

The contamination of riverine ecosystem through geogenic and anthropogenic activities has become a global concern. The study focused on the application of advanced tools and techniques, i.e., GIS, RS, and hybrid soft computing techniques for modelling, assessment and real-time monitoring of the Damodar River watershed. Comprehensive monitoring of the river for the two seasons, i.e., pre-monsoon and post-monsoon was carried out to establish the concentration range of various river water quality indicators (RWQIs) and their spatiotemporal variations. The study revealed that the concentration level of BOD, TC, EC, TDS, NO_3, NH_4-N, and Fe in river water exceeded their permissible limits. The AI-based relative-weighted-ensemble (AIRWE) hybrid model was found efficient for predicting BOD (R^2: 0.97, RMSE: 0.08, MAE: 0.07) and TC (R^2: 0.96, RMSE: 0.06, MAE: 0.05). The developed enhanced river pollution index (ERPI) indicated that river water was not fit for drinking ($ERPI_{DD} > 50$), while it appeared to be good ($0 < ERPI_{IIW} < 50$) for irrigation and industrial uses. An integrated approach comprising deterministic and probabilistic models with sensitivity analysis was used to assess heavy metal-associated health risks. The risk analysis revealed higher 95th percentile values than the permissible TCR (1.00E-06) and OHI (<1) in water and sediment which imparted unacceptable carcinogenic and non-carcinogenic health risks to children and adults. The geospatial techniques and multi-attribute decision-making approach used in site-suitability analysis depicted that 11.5% of the surface area falls under a highly suitable category for water and sediment harvesting structures in river watershed. Global environmental flow calculation model predicted MEF (15.4% - 25.8%) at various gauging stations, i.e., Tenughat, Konar, Panchet, Tilaiya, and Maithon, for sustainable management of the watershed. Integrated river-health investigation system (IRHIS) designed to monitor real-time river health performed well ($R^2 > 0.95$) in assessment of RWQIs. The developed protocol and outcome of the study could prove to be an excellent research tool for the scientists, policymakers, and regulatory authorities for sustainable planning and management of river health.