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Enhancing riverine load prediction of anthropogenic pollutants: Harnessing the potential of feed-forward backpropagation (FFBP) artificial neural network (ANN) models

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Abstract
Assessing riverine pollutant loads is a more realistic method for analysing point and non-point anthropogenic pollution sources throughout a watershed. This study compares numerous mathematical modelling strategies for estimating riverine loads based on the chosen water quality parameters: Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Suspended Solids (SS), and Ammoniacal Nitrogen (NH3–N). A riverine load model was developed by employing various input variables including river flow and pollutant concentration values collected at several monitoring sites. Among the mathematical modelling methods employed are artificial neural networks with feed-forward backpropagation algorithms and radial basis functions. The classical multiple linear regression (MLR) statistical model was used for the comparison. Four widely used statistical performance assessment metrics were adopted to evaluate the performance of the various developed models: the root mean square error (RMSE), mean absolute error (MAE), mean relative error (MRE), and coefficient of determination (R2). The considerable number of errors (with RMSE, MAE, and MRE) discovered in estimating riverine loads using the multiple linear regression (MLR) statistical model can be attributed to the nonlinear relationship between the independent variables (Q and Cx) and dependent variables (W). The feed-forward neural network model with a backpropagation algorithm and Bayesian regularisation training algorithm outperformed the radial basis neural network. This finding implies that, in addition to suspended sediment loads, riverine loads may be predicted using an artificial neural network using pollutant concentration (Cx) and river discharge (Q) as input variables. Other geographical and temporal fluctuation characteristics that may impact river water quality, on the other hand, may be incorporated as input variables to enhance riverine load prediction. Finally, riverine load analyses were successfully conducted to reduce the riverine load.

Author Keywords
Artificial neural network (ANN); Feed-forward backpropagation algorithm; Multiple linear regression; Radial basis neural network; Riverine load

Index Keywords
Ammonia, Biochemical oxygen demand, Dissolved oxygen, Errors, Mean square error, Radial basis function networks, River pollution, Rivers, Suspended sediments, Water quality; Artificial neural network, Feed-forward backpropagation algorithm, Feedforward backpropagation, Input variables, Load predictions, Multiple linear regressions, Pollutant concentration, Radial basis neural networks, Riverine load, Statistic modeling; Multiple linear regression

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