Application of Deep Learning and Soft Computing Methods for Prediction of Sediment Load in Reservoirs Owing to Climate Change

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(a) Purpose of study or research hypothesis
Climate change comprises of long-term alteration of rainfall pattern which results in escalated rates of soil erosion and higher sediment yield from watersheds. The sediment load is carried by rivers and transported to the sea in an unaltered river ecosystem but diversion structures like dams and weirs disturb the sediment cycle. The objective of this study is to obtain an accurate prediction of sediment deposition in a reservoir as function of climate change indices to achieve better sediment management.

(b) Key issue(s) or problem(s) addressed
Global annual reservoir storage loss due to sedimentation has an average value of approximately 1%. Consequently, it would be necessary to construct 300–400 reservoirs annually just to maintain current worldwide storage volume. Accurate prediction of reservoir sedimentation is difficult because phenomena involved, both hydrologic and hydraulic, are complex and intricate.

(c) Methodology or approach used
In this study, deep learning and soft computing approaches were employed to predict sediment load inflow at Sangju weir, South Korea. The Convolutional Neural Network (CNN) architecture of deep learning and two soft computing methods including Artificial Neural Network (ANN) and Adaptive Neuro-Fuzzy Inference System (ANFIS) has been utilized. Four input variables were selected including inflow, reservoir stage, water temperature, and release. The daily reservoir sedimentation data in natural form was set as the target variable. Various indicators were used for performance evaluation including Mean squared error (MSE), Willmott index (WI), and Pearson correlation coefficient (PCC).

(d) Results or conclusions derived from the project
Comparative analysis unveiled a high degree of accuracy for CNN, ANN, and ANFIS for setting up the relationship of four input variables and sediment deposition. The CNN architecture had superior performance than both ANN and ANFIS (MSE = 1.9628, WI = 0.974, PCC = 0.958).

(e) Implications of the project relevant to congress themes
The outcomes of this study are useful to model increased reservoir sedimentation rates as an impact of climate change. It is also an initial step to assess the damage of reservoir sedimentation and to suggest feasible prevention techniques for sustainable use of reservoirs.

Keywords : Climate change, Sediment deposition, Deep learning, Soft computing