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UNCERTAINTY ANALYSIS FOR ARTIFICIAL NEURAL NETWORK APPLYING MONTE CARLO SIMULATION TO FORECAST SODIUM ADSORPTION RATIO: A CASE STUDY, A FEW RIVERS IN IRAN*

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Abstract

Effective water quality management requires a thorough understanding of anticipated changes in the characteristics of surface and groundwater to support decision-making related to drinking water, irrigation, and industrial uses. Various mathematical models, such as time series approaches (including Box-Jenkins and Bayesian methods) and data-driven models, are utilized for forecasting water quality trends. Despite their usefulness, a significant challenge in applying these models is the inherent uncertainty in their predictions. This study evaluates the uncertainty of the Adaptive Neuro-Fuzzy Inference System (ANFIS) based on Fuzzy c-means clustering (FCMC) using the Genfis 3 model. Monte Carlo simulations were employed to predict the Sodium Adsorption Ratio (SAR) for the Aras, Sepid-Rud, and Karun Rivers. The findings reveal that for the Aras River, the combined standard uncertainty and expanded uncertainty for SAR were 0.58 and 1.16, respectively, with a gap of 2.412 ± 1.1622. Similarly, for the Sepid-Rud River, the combined standard uncertainty and expanded uncertainty were 1.11 and 2.22, respectively, with a gap of 2.235 ± 2.22. For the Karun River, the combined standard uncertainty and expanded uncertainty were calculated as 2.063 and 4.126, with a gap of 4.79 ± 4.126. Overall, the lowest uncertainty was observed in the SAR prediction for the Aras River, while the highest uncertainty was associated with the Karun River forecast using the ANFIS-FCMC approach.

Key words: ANFIS-FCMC, Monte Carlo Simulation, SAR, water quality

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