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Artificial intelligent techniques for optimizing water allocation in a reservoir watershed

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This study proposes a systematical water allocation scheme that integrates system analysis with artificial intelligence techniques for reservoir operation in consideration of the great uncertainty upon hydrometeorology for mitigating droughts impacts on public and irrigation sectors. The AI techniques mainly include a genetic algorithm and adaptive-network based fuzzy inference system (ANFIS). We first derive evaluation diagrams through systematic interactive evaluations on long-term hydrological data to provide a clear simulation perspective of all possible drought conditions tagged with their corresponding water shortages; then search the optimal reservoir operating histogram using genetic algorithm (GA) based on given demands and hydrological conditions that can be recognized as the optimal base of input-output training patterns for modelling; and finally build a suitable water allocation scheme through constructing an adaptive neuro-fuzzy inference system (ANFIS) model with a learning of the mechanism between designed inputs (water discount rates and hydrological conditions) and outputs (two scenarios: simulated and optimized water deficiency levels). The effectiveness of the proposed approach is tested on the operation of the Shihmen Reservoir in northern Taiwan for the first paddy crop in the study area to assess the water allocation mechanism during drought periods. We demonstrate that the proposed water allocation scheme significantly and substantially avails water managers of reliably determining a suitable discount rate on water supply for both irrigation and public sectors, and thus can reduce the drought risk and the compensation amount induced by making restrictions on agricultural use water.