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Genetic algorithms optimization of hedging rules for operation of the multi-purpose Ubonratana Reservoir in Thailand

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Abstract This study has developed optimal hedging policies for the multi-purpose Ubonratana Reservoir in northeastern Thailand based on its existing rule curves. The hedging policy was applied whenever the reservoir storage falls below a critical level for each month of the year. The decision variables, i.e. the set of monthly storages defining the critical rule curve that triggers rationing and the rationing ratio, were optimized by genetic algorithm (GA). Both single stage (i.e. with one critical rule curve and one rationing ratio) and two-stage (with two critical rule curves and ratios) of the hedging policy were considered in the optimization. To test the effect of the optimized hedging policies on reservoir performance, simulations were carried out, forced alternatively with the existing rule curves (i.e. without hedging) and the two optimized hedging policies. Performance was summarized in terms of reliability (time- and volume-based) and vulnerability. The results showed that the vulnerability was significantly reduced by using the optimized hedging rules. However, the number of water shortages increased with the optimized rules, causing the time-based reliability to worsen significantly. This should not be of concern since, although the number of shortages increased, the associated shortage quantities on most of these additional occasions were small, leaving the volumetric reliability largely unchanged.

Key words reservoir operation; rule curves; hedging policy; Ubonratana, Thailand; sustainability