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A rapid analytical model to represent dual-priority water rights in carryover systems

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Abstract: Water rights regimes are often employed in highly regulated water systems to achieve more efficient water use, further enrich water security, and address water scarcity issues. For example, in Australia, dual-priority water rights (e.g., high-priority water rights, HPWR, and low-priority water rights, LPWR) is a popular water allocation mechanism. In general, HPWR holders receive water resources first at the start of the season, and LPWR is allocated after that and in response to the actual available water (e.g., inflows, storage level, and weather). The current literature lacks a relatively simple way to represent the impact of water rights regimes on water availability. Hydrological simulation models are significant tools for simulating water rights regimes, but they are complex and demanding in terms of data and computation, which means that they are usually applied across a local single water system. Here, we present a simple analytical technique, based on Gould-Dincer (McMahon et al. 2007), to represent water yields in dual priority allocation systems from a carryover reservoir (Ren et al. 2022). We applied a dam simulation model to evaluate the technique across 15 rivers globally and four synthetic flow series. Five metrics, RMSE, NSE, relative BIAs, MAE, and R2, were applied to assess the goodness of fit between the water yield estimates from the dam simulation model and those from the analytical technique. The results demonstrate that the analytical technique is feasible. Furthermore, we illustrated the potential use of the technique to represent the optimum water yield between HPWR and LPWR based on reasonable carryover storage assumptions. The results further suggest that 'dual-priority' water allocation may offer overall benefits compared to a single-priority system. By balancing water yields of HPWR and LPWR, we can achieve the optimum marginal value of available water. Due to its simplicity, this approach provides a simple and efficient way for rapidly assessing optimal allocation practices at multiple scales in the context of climate change.

REFERENCES

McMahon, T., Pegram, G., Vogel, R., Peel, M. (2007). Review of Gould–Dincer reservoir storage–yield–reliability estimates. Advances in water resources, 30(9), 1873–1882.

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