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Embracing Scenario Thinking in Water Resources Management Under Deep Uncertainty

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Abstract: Traditional approaches to water resources management are increasingly inadequate in a world characterised by deep uncertainty (Wu et al., 2023). These methods often rely on the assumption that future water availability and demand and the outcome of planning decisions can be reasonably predicted, but this assumption no longer holds in the face of climate change, contested knowledge, and divergent stakeholder worldviews. Deep uncertainty—stemming from non-stationary exogenous inputs, incomplete or contested understanding of system processes, and differing human values—presents a grand challenge for water planners and decision-makers (Wu et al., 2025). Addressing this challenge requires a paradigm shift in how we conceptualise and manage uncertainty, moving beyond probabilistic forecasting to approaches that embrace the possibility of multiple plausible futures.

This study advocates scenario thinking as a systematic approach to navigating deep uncertainty in water resources management. We categorise key sources of deep uncertainty and outline how scenarios—conceived as internally consistent descriptions of alternative future states—can be used to address them. For uncertainties related to future exogenous drivers, scenarios may take the form of distinct trajectories or snapshots, enabling robust performance evaluation under a range of possible conditions. For uncertainties rooted in epistemic ambiguity and normative divergence, scenarios can be developed through stakeholder engagement processes and incorporated into decision-making tools such as multi-criteria decision analysis. By articulating these applications through real-world examples, we demonstrate that scenario thinking supports more resilient and inclusive planning outcomes and fosters a deeper understanding of the complex interdependencies between water systems and society. This work aims to facilitate the broader adoption of scenario-based methods, thereby contributing to more robust and adaptive water management in an increasingly uncertain world.

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