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Increasing water system robustness: potential of cross-sectoral water reuse

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We are increasingly confronted with drought damage in agriculture and nature as well as an increasing pressure on the availability of water for high-grade applications such as the production of drinking water. Strategies are being developed to control these risks and to secure long-term supplies of freshwater. These include increasing regional self-sufficiency in meeting the demand for freshwater and improving the utilization of the available water sources. We provide examples of adaptation measures to reduce the gap between water demand and availability under climate and water use changes, including reuse of water resources across sectors. Water reuse has the potential to substantially reduce the demand on groundwater and surface water. We present an integrative framework to evaluate the potential of water reuse schemes in a regional context and demonstrate how water reuse propagates through the water system and potentially reduces pressure on groundwater resources. The use of Sankey diagram visualisation provides a valuable tool to explore and evaluate regional application of water reuse, its potential to reduce groundwater and surface water demand, and the possible synergies and trade-offs between sectors. The approach is demonstrated for the Dutch anthropogenic water system in the current situation and for a future scenario with increased water demand and reduced water availability due to climate change. Four types of water reuse are evaluated by theoretically upscaling local or regional water reuse schemes based on local reuse examples: municipal and industrial wastewater effluent reuse for irrigation, effluent reuse for industrial applications, and reuse for groundwater replenishment. Doing so, we share a general framework for developing strategies to integrate water reuse in a robust regional water system. Responsible water reuse requires a multidisciplinary approach with knowledge on water demand and availability, water quality and health, technology and governance. Systematic evaluation of these aspects can help determine when water reuse is, or is not (!), a viable part of a regional strategy. This integrative context, including water systems thinking and modelling to identify risks and benefits, is essential for a successful implementation of water reuse in practice.