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## Trade-offs between water needs for food, utilities, and the environment—a nexus quantification at different scales

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With a growing population and a changing climate, competition for water resources in the water-energy-food (WEF) nexus is expected to increase. In this study, competing water demands between food production, freshwater ecosystems and utilities (energy, industries and households) are quantified. The potential trade-offs and related impacts are elaborated for different SSP scenarios with the integrated assessment model IMAGE, which includes the global vegetation and hydrology model Lund-Potsdam-Jena managed Land (LPJmL). Results for the 2045–2054 period are evaluated at the global scale and for a selection of 14 hotspot basins and coastal zones. On the global scale, we estimate that an additional 1.7 billion people could potentially face severe water shortage for electricity, industries and households if food production and environmental flows would be prioritized. Zooming in on the hotspots, this translates to up to 70% of the local population. Results furthermore show that up to 33% of river length in the hotspots risks not meeting environmental targets when prioritizing other water demands in the nexus. For local food production, up to 41% might be lost due to competing water demands. The potential trade-offs quantified in this study highlight the competition for resources in the WEF nexus, for which impacts are most notably felt at local scales. This emphasizes the need to simultaneously consider different dimensions of the nexus when developing scenarios that aim to achieve multiple sustainability targets.