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Exploring hydrological scenarios in an irrigation-intensive landscape

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The Western US state of Idaho ranks 39th in terms of population and is the second largest irrigator in the nation. Agriculture comprises 97% of total human water use and over the last 20 years the region's economy shifted dramatically towards the dairy industry.

Our study area, the Upper Snake River Basin (USRB) in southern Idaho, is a semi-arid, snow melt-dominated basin with extensive river impoundments to support irrigation and livestock. The expansive Eastern Snake River Plain Aquifer (ESPA) under much of the basin stores a significant volume (up to 600 cubic km), with recharge from incidental irrigation excesses a major component of the water balance in some portions of this heavily utilized aquifer. We use the UNH Water Balance Model to explore regional scale sensitivity under a range of scenarios of this complex human-hydrological system. These model experiments allow us to bound important aspects of the hydrological system under possible future management strategies, and to map human and environmental resilience and vulnerability to changes in water availability. Scenarios include changes in agricultural technologies including both water conveyance and application systems, varying regimes of artificial recharge to the ESPA, modifications to the system of water rights controlling who is allowed to use water and when, precipitation and temperature variability, and changes to the dominant agricultural industry. Simple metrics such as growing season domestic, livestock and irrigation water availability, hydropower generation potential, contaminant dilution capacity, and aquifer discharge (critical to the aquaculture industry) characterize the resilience and vulnerability of the system. These simulations will inform future work that uses stakeholder decisions to drive governance and economic modeling of possible future socio-ecological technological systems for the USRB.