An operational sociohydrological model to understand the feedbacks between community sensitivity and environmental flows for an endorheic lake basin, Lake Bakhtegan Iran

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Climate change, drought, overuse of water from surface(-ground) water resources has caused major problems in endorheic basins across the world. One such basin is Bakhtegan Lake Basin, southwest of Iran. The water entering Bakhtegan Lake has decreased, which has led to a decrease in the water level of this lake. Secondly, groundwater level has decreased in the Bakhtegan aquifer. These problems occurred in the Bakhtegan basin as a result of neglecting human roles as theactive agency within the hydrology of the region. In this study, we present a sociohydrological model in order to simulate dynamic relationship between community sensitivity, which responds to environmental well-being, and water use state variables as key to understanding the competition between water allocation between agriculture and the environment in the basin. Furthermore, agriculture in this basin plays a key role in the economic livelihoods which in turns plays a major role in the competition of water allocation between agriculture and environment in the Bakhtegan area.

The sociohydrological model is developed by coupling water demand and balance based WEAP (Water Evaluation And Planning) model with community sensitivity dynamic equations of the sociohydrological model by Roobavannan et al. (2017). The unique aspect of this model is that the six parameters of the community sensitivity related equations are calibrated, while being coupled to WEAP, using Elitist Non-Dominated Sorting Genetic (NSGAII) Algorithm on observed annual streamflow at three gauges within the basin.

The results demonstrate that the calibrated coupled model is able to simulate past allocations of water to agriculture and the environment in the basin, which we compare with available records. Further, we provide non-dominated pareto set of parameters, that demonstrate equifinality in pareto superior parameters of community sensitivity.

References:

Roobavannan, M., Kandasamy, J., Pande, S., Vigneswaran, S., & Sivapalan, M. (2017). Role of sectoral transformation in the evolution of water management norms in agricultural catchments: A sociohydrologic modeling analysis. Water Resources Research, 53, 8344–8365. https://doi.org/10.1002/2017WR020671