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Water policies for sustainable agriculture in the Yanqi Basin, China.

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Abstract
The Yanqi Basin is one of the agriculturally most productive areas in China's western province Xinjiang. Precipitation in the region is only about 50 mm per year, and therefore agriculture is based completely on irrigation. The Kaidu River and 3 smaller rivers carry water into the basin. About one third of the inflow is used for irrigation, the rest is received by Bostan Lake, which is one of the largest freshwater bodies in the west of China.
Continued agricultural production with flood irrigation will cause severe environmental problems in the basin: an increased salinisation of agricultural soils, an increased salinisation of Bostan Lake, a reduced water level in Bostan Lake, and an insufficient outflow from the lake, which jeopardises forests of desert poplars as well as agricultural production and electricity production in the downstream area of the basin. In other words: "business as usual" is ecologically not sustainable.
With our work we present water policies to promote the diffusion of water conservation technologies that allow for a continued and ecologically sustainable agricultural production. We generate scenarios and analyse simulations with an integrated economic and hydrological model. The time horizon of the scenarios is 30 years.
The economic model is by and large a simple accounting model that determines quantities of agricultural production and water consumption as well as revenues, costs, and profits in the agriculture and water sectors. A key aspect on the water demand side of the model is the diffusion of drip irrigation as a substitute for the inefficient flood irrigation wherever possible. Policy variables on the supply side include the price of water, subsidies for drip irrigation, investments in the renovation of irrigation channels to reduce transport losses, and investment in wells and pump stations to supply groundwater, with the latter simultaneously reducing phreatic evaporation due to the lowering of the groundwater table.
Based on the water demand and supply variables of the economic model a sophisticated hydrological model calculates all water flows, the level of the groundwater table in the basin, the water level in the lake, and the overall water balance of the system. Moreover, the hydrological model computes the salt transport and salt concentrations in irrigation and drainage channels, in the groundwater, in Bostan lake, and in soils. Yield-loss functions translate soil salinity into crop-specific yield losses.
Particularly the parameters of the economic model suffer from substantial uncertainties about their true values. Therefore our scenarios include built-in sensitivity analyses of parameter variations based on sets of "most likely", "pessimistic" and "optimistic" estimates.
Based on the design and analysis of 6 scenarios we can identify water policies that lead to a path towards ecological sustainability in the basin. Policy-induced changes include the diffusion of drip irrigation, the switch towards a full-cost water price regime, the renovation of the irrigation channels to reduce transport losses, and the partial substitution of surface water abstraction by groundwater pumping. These changes suffice to keep the salinity of Bostan Lake at uncritical levels and to even increase the outflow of the lake, benefiting the downstream area of the Kongque River. Our results are certainly of preliminary nature, but relatively robust with respect to the uncertainties afflicting the estimated parameters of the economic model.