



Evaluation of Water Policy Interventions in the Face of Climate Change: Insights from the Colorado River Basin

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The exceptional low water inflows and the inadequate water allocation during the early 21st century led to a crisis in the Colorado River Basin (CRB). The crisis revealed the vulnerability of the system and the needed changes of the water policies. Climate change worsens water scarcity and increases the risk of extreme drought events, with impacts on the water-dependent economic sectors in the USA and Mexico. Water management requires policy interventions to address the emerging conditions resulting from climate change. The submitted paper analyzes the risk and economic impacts of climate change in the CRB. Using a hydro-economic model (HEM), we compare the economic benefit of the current allocation rules with alternative policies: cap-and-trade and social planner allocations. The HEM incorporates hydrology, agriculture (39 crops across 2.2 million acres distributed in 40 irrigation districts), urban water use (379 cities, 33.4 million people), and hydropower generation (9 plants, 10,225 gigawatt-hours annually). Future runoff simulations are based on climate change projections and a statistical method called copula, which generates synthetic time series of water inflows with similar characteristics to the projections. The model operates on a monthly temporal scale over a simulation window of 30 years. The model operates on a monthly timescale over 30 years, with 100 simulations for each policy under both historical and projected climate conditions.

The results are interpreted statistically to provide a range of potential outcomes and their likelihood. The analysis reveals the probabilistic distribution of water curtailments and their impacts on different users and regions. The analysis provides insights into the basin's vulnerability to climate change. The economic benefits of the social planner water allocation are compared under the current policy and a cap-and-trade policy to assess the costs associated with each. The analysis explores the potential benefits of water trade among sectors, states, and Tribal Nations, identifying potential cooperative arrangements among stakeholders. Inter-state cooperation and economically beneficial arrangements among stakeholders could enhance water use efficiency. The rigidity of the current system can lead to maladaptation to climate change. The agricultural sector is examined to identify potential crop pattern changes for adaptation. Additionally, the analysis assesses risks within urban areas. The shadow price of water in the border between the USA and Mexico is estimated as a proxy of the compensation from water users in United States to those in Mexico.

