

## **Hydroeconomic modeling framework for assessing vulnerability to water demands in arid regions**

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**Abstract.** In semi-arid regions with rapidly growing cities, agricultural water rights are being purchased primarily by municipalities, consequently drying up historically irrigated land according to the water right appropriation doctrine, a process termed “buy and dry”. The goal of this study is to develop an assessment framework to evaluate impacts of population growth, land use change, conservation, and institutional agreements on water shortage vulnerability, the agricultural economy, and cost of water rights purchases to municipalities. A hydroeconomic model is presented that solves the permanent water rights market as growing municipalities attempt to purchase water at the least cost from profit-maximizing agricultural producers. In a case study region, the South Platte River Basin, the model shows 85-90% of total regional agricultural profit over a planning period of 40 years is attributed to sale of water to cities. Several different types of management practices being considered in the basin were studied to show the efficacy of sustaining agricultural production and consequently the rural economy. A few practices achieved the goal of sustained agricultural cropland in production, profitability of production, and productivity at the cost of lost water rights sale revenue or reliability of water supply. Some failed at sustaining either cropland or productivity. When considering only agricultural profit, the worst paths forward would be to cap municipal growth or pursue aggressive urban conservation. When considering the cost to municipalities the worst path forward would be to cap municipal ownership. Otherwise, practices usually save money for municipalities. When considering total agricultural crop production, the worst practice to implement is a fixed reduction of land purchase requirements relative to the amount of water used. All practices failed at improving total agricultural profit when considering the revenue from sale of water rights. Thus, this study raising the question, should anyone intervene with agricultural buy up when it might not really be in their interest to do so?