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Optimizing water supply options for a region with urban-rural interactions

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Abstract: Water scarcity threatens to reduce or eliminate agricultural production from semi-arid regions with rising urban populations and environmental regulations that inhibit infrastructural investment. Although this transition in water from agricultural use to municipal use may be the economically efficient outcome for those involved with water trades, lower income rural communities are typically disproportionately damaged when benefits from sale of land and water are directed outside of rural regions. However, when benefits of sold water remain local as may be the case in the South Platte River Basin, selling more water will actually benefit local agricultural communities more than continued production. At the same time, water rights prices and treatment costs are so high that municipalities can save more money by conserving than by purchasing new supply. The municipal choice to conserve, thus, reduces costs for municipalities, but reduces financial benefits to local agricultural communities. A multiobjective framework is presented that exposes these tradeoffs inherent in water management decisions across sectors that assist regional and state water planners in identifying policy and conservation targets. Out of the five supply options within the model (agricultural water, water storage reservoirs, efficient toilets, xeriscaping, and upgraded irrigation technology), adoption of xeriscaping most significantly reduces municipal cost and irrigation technology most significantly benefits agricultural communities. Out of institutional changes considered, reducing raw water requirements saves municipalities the largest amount of money, while reducing the number of permanently fallowed cropland through deficit irrigation, permanent fallowing, or rotational fallowing provided the widest range of benefits across both sectors.

***Keywords**:* Water supply; multiobjective optimization; hydroeconomic