The Economic and Ecological Tradeoffs of Agricultural Water Use Demand Management in the Upper Green River Basin of Wyoming

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Abstract

Agricultural water users in the Upper Green River Basin (UGRB), a primary sub-basin of the Colorado River Basin, participated in the System Conservation Pilot Program during the 2015 through 2018 irrigation season. This program explored the feasibility of a demand management program that pays water users to temporarily reduce their consumptive use of water to maintain the reservoir elevation of Lake Powell needed to protect Colorado River compact flow obligations and to maintain hydroelectric power production. While demand management increases water available for drought contingency storage, it can reduce the presence of artificial, irrigation-influenced wetlands that provide habitat for migratory waterfowl and reduce return flows that provide late-season habitat for fish. Our objective in this study is to model the economic and ecological tradeoffs of compensated agricultural demand management between three stylized study sites in the UGRB. We do this using an optimization model in GAMS that considers location-specific economic (e.g., crop type/yield and variable cost), hydrologic (e.g., soil type and timing of irrigation) and ecological characteristics (e.g., presence of fish habitat and of natural versus irrigation-influenced wetlands). In our baseline scenario, landowners choose cropping activities that maximize profit subject to regulatory, hydrologic, and ecological constraints. Then we add a demand management program in which landowners are compensated at a fixed rate for cropping activities that reduce consumptive water use. Then we allow the compensation to vary by study site, reflecting location-specific hydrologic and ecological characteristics. Finally, we examine these three policy scenarios with minimum consumptive use savings constraints (various target savings). The model output indicates spatial patterns of compensation, consumptive use savings, and economic and ecological change across the three study sites under each policy scenario. Preliminary results suggest that spatial targeting of demand management can improve overall cost-effectiveness of a demand management program by accounting for economic, hydrologic, and ecological heterogeneity within the UGRB. There is anecdotal evidence that water use reductions change the composition of grasses and improve yields in future growing seasons, which suggests that compensation for water use reductions may not be necessary in the long run once producers are familiar with new agronomic practices.

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