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Influence of crop-water production functions on the performance of economic instruments for water conservation

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In water scarce basins, the agricultural economics modeling literature predicts water demand and supply curves with significant inelastic intervals, which limit the cost-effectiveness of charges and water reacquisitions in reallocating water to the environment, respectively. Such models typically rely on yield point predictions that are obtained as an average of past observations, while water input application per crop is assumed constant on a per hectare basis. Yield point predictions allow modeling irrigator's adaptation at the extensive (land reallocation towards less water-intensive crops) and super-extensive margins (land reallocation towards rainfed crops); yet, they are not suitable for modeling adaptation at the intensive margin, which involves decremental water input application through deficit irrigation -an increasingly frequent response to water scarcity in arid and semi-arid basins. This paper introduces agronomic calibrated production functions into a multi-attribute positive calibrated model to simulate adaptation at the intensive, extensive and super-extensive margins. The model is illustrated with an application to the El-Salobral-Los Llanos irrigated area in the Mancha Oriental (Spain). Agronomic production functions are calibrated for the main crops in the area, namely wheat, barley, corn, alfalfa and onion, which represent 78% of agricultural land use. Results for a hypothetical policy that increases charges from 0 to 100 Eurocents/m^3 suggests a relevant role for intensive margin adaptation in the case of cereal crops; while farmers prefer to fully irrigate more profitable horticultural crops (onion). As a result, introducing adaptation at the intensive margin results in a significantly more elastic water demand curve. For example, at a charge increase of 20 Eurocents/m3, the model using agronomic production functions predicts a water conservation of 3855 m3/ha; as compared to 3123 m3/ha in the model relying on yield point predictions (a non-negligible difference of 18.97%).