Informing policies on sustainable water uses in a developing country setting: Assessing the value of water in Uruguay

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Introduction

- Concerns about freshwater availability and quality are mounting in many places of the world ranging from developing to industrialized countries
- The sustainable development goals (SDG) of the United Nations include since 2015 more than one goal that relate to water resources.
- Developing countries in particular face difficult choices in order to promote economic growth that is environmentally sustainable and socially inclusive
- Uruguayan legislation indicates that all surface and groundwater is public, and that the government, which administers extraction rights and usage limits by agricultural users can charge a water extraction fee
- The current administration is studying the possibility of charging the agricultural sector for that usage.
- Implementation of water fees has the potential of promoting more sustainable uses of water, and of raising revenues to be used for other government goals, however it will induce changes in land use with impacts on the environment, employment, and potentially other social and economic indicators.

Application ,data, and results

About the data

Data for the agricultural census for Uruguay in 2011 was obtained to observe land use at the minimum censual units (the country is subdivided into roughly 630 units)

Data on production, prices and costs by subdivision was obtained

The model contained 6 activities:: rainfed agriculture, irrigated agriculture, livestock (beef and sheep) production, dairy production, and forestry.

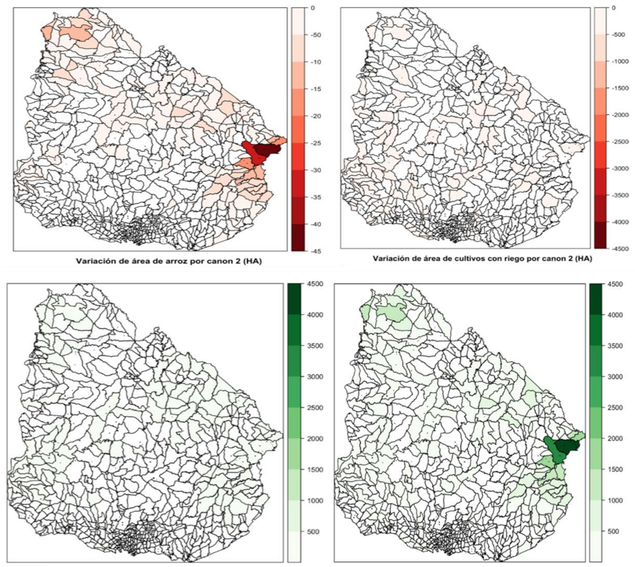
Main results

-Introducing water fees as expected reallocates land from water intensive uses (rice and irrigated crops) to less water intensive uses (rainfed crops, livestock)

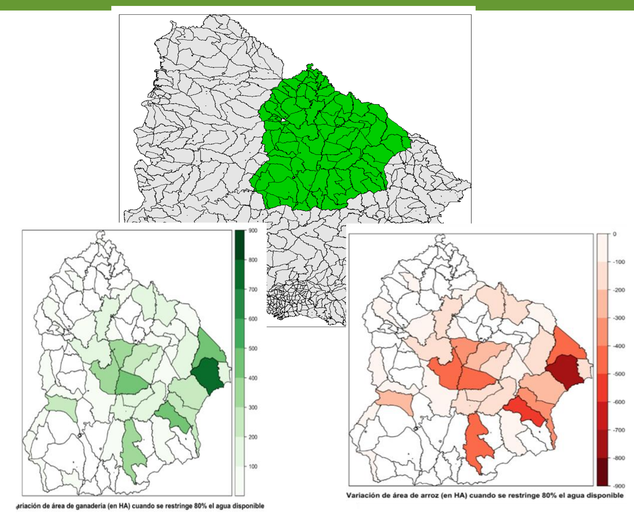
-Returns to production declines being producers in the South and north the most affected in the country

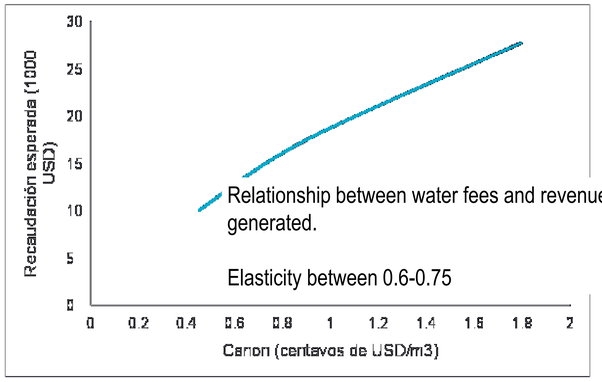
-A concave relationship between water fees and revenue collected emerges

-Shadow values emerge when water availability is restricted, and the implications on land use and land use change is consistent with the reallocations observed from introducing water fees.



Reallocation of land use in response to water charges





Model

- Land use models developed by Merel et al. (2011) and Garnache and Merel 82011) were used.
- These models allow for exact calibration to observed land uses and exogenous elasticities
- Multiple restrictions can be included,.
- Producers maximize profits by allocating land to different activities facing restrictions in terms of land and water availability

$$max_{x_i \geq 0} \sum_{i=1}^{I} (p_i \alpha_i x_i^{\delta_i} - (C_i + \lambda_{2i}) x_i)$$

Subject to: =

$$\sum_{i=1}^{I} x_i \leq X$$

$$\sum_{i=1}^{I} \gamma_i x_i \leq A$$

$$\eta_i = \frac{\delta_i}{1-\delta_i} \left[1 - \frac{\frac{\bar{x}_i^2}{p_i \bar{q}_i \delta_i (1-\delta_i)}}{\sum_{J=1}^{l} \frac{\bar{x}_j^2}{p_j \bar{q}_j \delta_j (1-\delta_j)}} \right]$$

Calibrating to exogenously imposed elasticities

Final remarks

This work utilized well known models of land use allocation to analyze the value of water in a developing country setting, calibrated to the latest agricultural census

Results illustrate the land use impacts of different levels of water use fees for agricultural production, as well as the shadow values, reducing water availability in the optimization model. Results in terms of land use change are consistent between approaches.

An elasticity is calculated for the relationship between water use fees and the generation of government revenues.