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The Extended Water Footprint and illegal groundwater use in the Upper Guadiana Basin (Spain): can increased productivity explain non-compliance?

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Introduction

Tablas de Daimiel National Park is located in the Upper Guadiana Basin and represents one of the largest and most important wetlands in Europe. The long term ecological integrity of this wetland is inherently associated with the maintenance of a shallow groundwater table, namely the Western Mancha aquifer (WMA) or Aquifer 23. The intensive use of groundwater, mainly for irrigation, has led over the last decades to deep socio-economic changes. Such intensive use has also lowered the water table of Aquifer 23, drastically reducing the flooded area of the wetland and threatening its ecological integrity. A number of plans and measures have been developed and implemented since the declaration of overexploitation of Aquifer 23 in the year 1987. The most recent one is the Special Plan for the Upper Guadiana (SPUG), approved in 2008. This Plan is the main measure to comply with achieving the objective of good quantitative and qualitative status required under the Water Framework Directive (2000).

This paper offers a new type of integrated analysis which allows assessing under a common lens the physical, economic and social dimensions of groundwater use in the area. The first objective is to calculate the groundwater footprint of agricultural production in the Upper Guadiana basin and its evolution during 2000-2008. For this purpose, we have applied the Extended Water Footprint (EWF) methodology -a novel approach based on the classical Water Footprint (WF) approach- that includes an assessment of the water productivity from an economic and social perspective. Compared to the classical WF, the EWF allows for a more complete overview of the sector, providing new insights for policy decisions (e.g. to define options and possibilities on water re-allocation in order to achieve both better ecosystem conservation and social equity). The second objective is to use the EWF to compare the existing authorized and non-authorized or illegal use of water. This allows us to discuss current initiatives by public authorities in relation to the existing frame of water rights.

Key words: Aquifer intensive use; Economic and social groundwater productivity; unauthorized water use

Methods

To calculate the WF (volume of groundwater consumed by each type of crop) we used an indirect method: the evapotranspiration rate of plants associated with the area of crops irrigated with groundwater, whilst taking into account some administrative, economic and physical restrictions on the availability of groundwater. Surfaces areas of legally irrigated crops were obtained from annual statistics elaborated by the Autonomous Communities. Crops considered in this study represent 90% of the total irrigated area. To estimate the surface of non-authorized irrigated areas, we use the data provided by a remote sensing study included in the SPUG. The economic dimension

of water productivity has been measured through the added value generated by the different crops. The social dimension of water productivity was quantified through the direct and indirect labor linked to the production of crops.

Results

There is a large gap between the WF and the current added value most representative crops generate in the Western Mancha Aquifer. Almost 75% of the total agricultural WF is due to the production of vine and barley, in similar proportions. However, vine on its own generates more than 60% of the total added value of irrigated crops, while barley only accounts for 3%. The remaining 37% of the added value is due to the production of vegetables (mainly melon, pepper, garlic and onion). Similar differences between barley and vine production are obtained when considering the labor associated with their production.

Between 2000 and 2008 both irrigated vine and cereals areas have increased (the time span of this study doesn´t allow to observe the consequences of the 2010 reform of the EU CAP for cereals). Meanwhile the area of vegetables has remained constant over the same period. The overall rise in water demand for vine and cereals means a higher pressure on groundwater resources.

Concerning the legal and illegal groundwater abstraction, 10% of the cereal WF is illegal. In the case of vine and vegetables the illegal WF part is greater, accounting for almost 30% of its total WF. These results imply that most unauthorized water is used to produce the most socially and economically efficient crops (vine and vegetables).

Discussion and Conclusions

The above results point that a potential re-allocation of groundwater use on both environmental and social grounds is plausible as foreseen in the SPUG. At the regional level, gains associated with the increased area in irrigated vine, to produce quality wine, could help compensate potential economic losses from a reduction in e.g. irrigated cereals, currently exposed to global market fluctuations. It is also the case that EU CAP reforms to decouple payments and production would have to sustain the revenues of the farmers switching to dry land farming. At the farm level, however, the consequences of such measures are difficult to assess.

To date the observed increase in vegetables and irrigated vine area does not match the static and rigid pattern of existing water rights. The underlying corollary is a key finding of this research: Farmers are willing to risk non-compliance for higher profit crops, as long as the existing legal framework does not incentivize an evolution towards more economic efficient and less water consumptive crops. This situation explains partly the overall intensification of groundwater use in the Western Mancha Aquifer.

Our results could also explain the reticence of the authorities to take drastic action, since closing unauthorized wells would cause high social, economic and, consequently, political costs. According to our results, the “black underground water economy” accounts for approximately 30% of the regional added value generated by irrigated crops. The SPUG was developed to purchase existing water rights to be re-allocated on both social and environmental grounds, to users which currently use water illegally and also to free up resources for aquifer recharge. However, the overall high costs of these measures questions the actual implementation and effectiveness of this policy.