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Modelling combinations of economic instruments to eliminate depletion in the Alto Guadalentín aquifer (SE Spain)

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Abstract:

This paper analyses the cost-effectiveness of combining several policy instruments to address the problem of non-renewable pumping in the *Alto Guadalentín* aquifer in Southeast Spain, one of the most extreme cases of aquifer depletion in Europe. Their economic impact is assessed using a partial equilibrium non-linear mathematical programming model that maximises the farm net margin resulting from the use of the available water resources for irrigation in the area. Our results show that all the alternatives have significant economic impacts, although the future availability of desalinated resources would notably mitigate them, as farmers can substitute groundwater with desalinated water. Although the outright restriction of non-renewable pumping and an environmental tax on extractions imply the lowest level of public expenditure, they are very unpopular and have a large political cost. The buyback of groundwater rights and the subsidisation of desalination in exchange for reducing groundwater pumping have the same impact on the rural economy of the area than the previous measures, but are likely to be much better received by farmers, as their cost would rest on the public budget. A combination of instruments would share the cost of aquifer recovery among farmers and the administration. The choice of the optimal policy mix will therefore depend on the trade-off between farmers' income and public expenditure, the relative importance given by policy makers to each criterion and the opposition that each measure may receive from stakeholders.

Keywords: *groundwater; irrigation; desalinated seawater; water economics; mathematical programming.*