

Collective Action in Groundwater and Ecosystem Management: the Failure of Economic Instruments

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INTRODUCTION

Most prevailing environmental policies are based on compensating the agents who are damaging the environment or on making large investments in restoring natural reserves. An example of failure of these policies is illustrated here by comparing two large groundwater systems in Spain with contrasting management strategies. The appeal of the case stems from the fact that the Eastern La Mancha aquifer is being managed almost sustainably. In stark contrast, its neighboring Western La Mancha aquifer is being grossly mismanaged. The results engage two major questions from previous groundwater literature. The first question is whether aquifer management needs policy intervention. The answer depends upon the consideration and magnitude of environmental damages in the model. The second question addresses the nature of groundwater policies. The empirical findings challenge the current approach to environmental policies and call for policy efforts focused on nurturing stakeholders' collective action and on supporting the necessary institutional setting.

PROBLEM STATEMENT

The valuation of the environment has been a swelling endeavor for environmental economists during past decades, with a plethora of scholarly discussions surrounding valuation procedures. However, the key issue in environmental policy is not the accuracy of valuation but rather how to internalize ecosystem damages into agents' economic decisions. The current policy practice for protecting ecosystems consists of compensating interventions using market instruments for private benefits of local agents who cause the damages, or promotion of conservation programs for natural resource reserves using large investments by governments, international agencies and private foundations. Such policies seem ineffective in curtailing the massive degradation of natural resources and ecosystems worldwide.

There are two basic economic approaches to deal with common pool resources, such as groundwater. One approach is the "Coase solution", which is based on privatizing the resource, and the second approach is the "Pigou solution", which is based on public ownership and taxation of extractions. Hardin has described how population pressures bring about the exhaustion of common pool resources, recommending privatization or public property coupled with access regulation. However, Ostrom has proposed an entirely different approach by questioning the idea that common property governance leads inexorably to tragedy. Ostrom looks at the empirical evidence of the management of common pool resources, and finds that coercive government rules fail because central authorities lack legitimacy and knowledge of local conditions. Stakeholders themselves have to design the rules and the enforcement mechanisms for the sustainable management of common resources. Also, interactions among stakeholders necessitate appropriate institutional settings from local to regional levels, in order to restrict access and create incentives to conserve resources.

The contrasting examples of two large aquifers in Southern Spain—the Western and Eastern La Mancha aquifers and the adjacent wetlands—reveal the mismanagement and failure of pure economic instruments in Western La Mancha. Conversely, the observed progress towards sustainable management in Eastern La Mancha due to the success of the collective action engaged by stakeholders

STUDY AREA, MODEL AND RESULTS



Dynamic model, with extraction cost externality and environmental externality

$$\text{Max} \int_0^{\infty} e^{-rt} \left[\frac{1}{2k} W_t^2 - \frac{g}{k} W_t - (C_0 + C_1 H_t) W_t - \beta [-(\alpha - 1) W_t - R] \right] dt$$

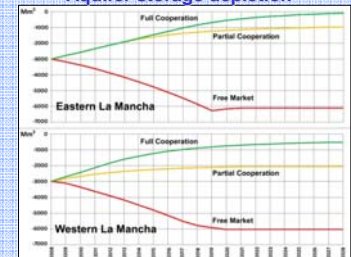
Water table solution equation

$$H(t) = \frac{-(\alpha - 1)(g + kC_0 + kC_1 H_0 - \beta(\alpha - 1)k) - R}{(\alpha - 1)kC_1} + \frac{R}{rAS} + \left[\frac{(\alpha - 1)(g + kC_0 + kC_1 H_0 - \beta(\alpha - 1)k) + R}{(\alpha - 1)kC_1} - \frac{R}{rAS} \right] e^{t\lambda_2}$$

Water extractions solution equation

$$W(t) = -\frac{R}{(\alpha - 1)} + \left[\frac{R}{(\alpha - 1)} + g + kC_0 + kC_1 H_0 - \beta(\alpha - 1)k - \frac{kC_1 R}{rAS} \right] e^{t\lambda_2}$$

Cooperation scenarios Aquifer storage depletion

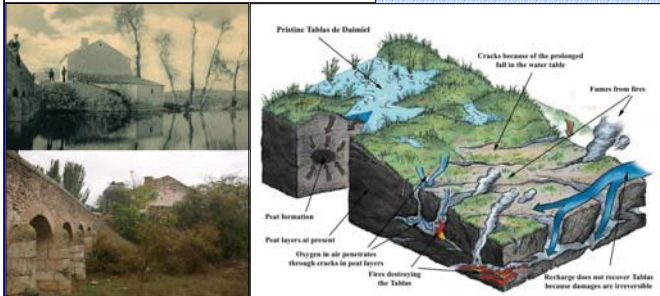
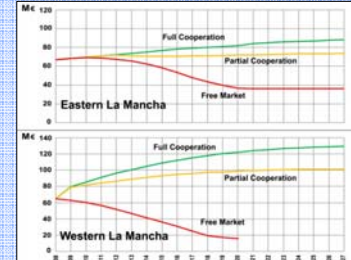


Extractions during last decade

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Extractions, Eastern La Mancha (Mm ³)	420	390	380	370	370	380	350	290	270	300
Extractions, Western La Mancha (Mm ³)	590	610	680	650	620	430	670	610	440	490

The contribution of this study is in the demonstration of the efficacy of collective action by farmers in Eastern La Mancha, compared with the use of economic instruments (and lack of cooperation) in Western La Mancha. Economic instruments: payments of 200 million Euros in the 1990s and planned investments of 5.5 billion Euros under the Upper Guadiana Special Plan

Social welfare



CONCLUSIONS

The results from La Mancha engage two major questions on groundwater management. The first question is whether or not "free market" approaches are good enough for groundwater management, or do aquifers need policy intervention? The theoretical results indicate that policies can improve social welfare substantially when environmental damages are considered, while "free markets" lead to ecosystem degradation coupled with depletion of resources for human activities.

The second question is: what should be the nature of policies needed for groundwater protection? The empirical results suggest that compensation payments to avoid damages through market instruments, or large investment schemes in nature protection have failed in Western La Mancha. Empirical results from the Eastern La Mancha aquifer indicate that policies that support collective action are needed. The huge 5.5 billion Euros in public expenditures by the Upper Guadiana Plan seem to be a misguided policy to recover the aquifer, because stakeholders' cooperation requires serious commitments to manage and care for the aquifer, and cannot be exclusively bribed for by side payments.

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