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Recovering the costs of irrigation water with different pricing methods: Insights from a Mediterranean case study

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ABSTRACT

A key guideline of the European Water Framework Directive (WFD) asks to cover water costs in a way to encourage the efficient use of the resource, therefore its protection, but minimizing possible adverse environmental, social and economic impacts of cost recovery. We use a Mathematical Programming model of an Italian, Mediterranean agricultural area where a Reclamation and Irrigation Board (RIB) manages collective irrigation facilities, to simulate the impact of replacing the existing pricing system with several alternatives, at different degrees of water cost recovery. We estimate the water distribution cost (WDC) of the RIB with a *Translog* cost function, and consider the cost incurred by the Sardinian water agency (ENAS) for maintaining regional dams and primary water infrastructures. We also consider that a Regional subsidy pays part of the RIBs and ENAS energy cost for water lifting, and that ENAS rates are modulated among end-users to reduce agricultural fee by increasing the charge on industrial uses. We simulate the impact of alternative pricing under four scenarios of cost recovery: (i) current partial recovery of WDC, with no ENAS charge; (ii) current recovery of WDC, plus ENAS cost at modulated agricultural rates; (iii) full coverage of WDC, i.e. absence of the Regional aid, plus ENAS cost at modulated agricultural rates; (iv) full coverage of WDC, plus unmodulated ENAS rate. Solely changing the water pricing system, at current cost recovery level, generates limited total impacts, but substantial income redistributive effects among farm types whose magnitude grows increasing the level of recovery. The full cost recovery scenarios generate remarkable global impacts and drops of income in the single farm types, particularly when applying ENAS undiscounted rate. Major consequences also emerge for the use of water and other productive factors, and labour employment.

1. Introduction

One of the key guidelines of the Water Framework Directive (WFD) is to combine economic principles and tools (*polluter pays*, and *pricing*) to achieve environmental goals, while ensuring *full cost recovery* (FCR) of water services, and adequate incentives to efficiently use water (European Commission, 2000; Massarutto, 2007; Martin-Ortega et al., 2015). The European guidance document on the Directive précises how to plan and organise the economic analysis in implementing the water policy (WATECO, 2003). Besides, Article 9 of WFD recognizes that applying efficient water pricing may raise social and redistributive concerns, and establishes that Member States may consider social, environmental impacts and economic in planning the mode and level of cost recovery. This aspect is important. On it, Reynaud (2016) shows that increasing water payments for domestic use could mainly affect the most vulnerable social groups. From the agricultural perspective, Venot and Molle (2008) stresses that raising taxes on the water taken from farms wells does not involve significant savings of that resource, and can further reduce the profitability of extensive crops or low income. In the case of irrigation water supplied by collective facilities, Dono et al. (2010) stress that if the latter are underused, FCR rates could be based on average costs that are much higher than the marginal costs: uncontrolled extractions of groundwater may result where this resource is available, or negative impacts on incomes where not. Definitely, pursuing FCR by increasing water payments might generate a vicious circle favouring the use of sources difficult to protect, appreciably affecting low income users and reducing the use of collective services (Azevedo and Baltar, 2005; Reynaud, 2016).

According to a recent report of the European Commission, not all Member States apply transparent water pricing, and Greece and Italy are particularly lagging behind in adapting (European

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Commission, 2015).[1]: a solicitation arises for many national and local water authorities, to recover the delay. Our analysis takes its cue from this commitment, and assesses the possible impact of various pricing methods in an irrigated Mediterranean area of Sardinia (Italy) where a *Reclamation and Irrigation Board* (RIB) distributes water to farms[2] Our goal is twofold. First, assess the impact of replacing the current pricing with alternative systems, including *volumetric*, often regarded as the most effective in promoting efficient use of water. Second, evaluate the effect of including all the costs of water in the irrigation rates, and, indirectly, assess the choice of Regional Authorities to limit this transfer to farms. The next section, *Background*, illustrates aspects of the scientific debate that are relevant to our study. Section *Materials and Methods* describes the study area, the approach for assessing the impacts of water pricing and cost recovery, with simulated pricing systems, and the estimation of water costs. The *Results* section reports the economic, and some environmental and social impacts of the simulations. The *Discussion* section assesses the impacts of the pricing systems, and the *Conclusions* follow.

2. Background

2.1. Scientific debate on water framework directive

Several aspects of the scientific debate on WFD are relevant to our study. A first issue is identification of the costs to be recovered in agriculture: Garrido and Calatrava (2010) classify monetary costs in three categories. The irrigator pays *private costs* as any other farming cost, such as energy, maintenance and labour. The pricing and water allocation policies can have major impacts on them, leading to change the source of supply, for example encouraging use of groundwater, or the adopted irrigation technologies. Another category is the *costs of the irrigation district*, or *scheme*, for the management and maintenance of water distribution systems to individual farms. RIB*s* manage most of the Italian schemes, and about 63% of irrigation water (Bellini, 2014), and charge specific tariffs to farmers (INEA, 2011), project capital costs are publicly funded. Finally, the *Water Authority costs* pertain to governmental agencies that manage large dams and infrastructures, debiting related costs to end-users and taxpayers: and it is interesting to examine the distribution between the two groups (Garrido and Calatrava, 2010). Complex and site-specific analyses are required to estimate and include in the FCR environmental and resource costs. The former consist of *non-use values* associated with obtaining a healthy functioning of aquatic ecosystems, and *use values* of water environment (Drafting Group ECO2, 2004). Resource costs arise when alternative uses of the water generate higher economic value than present use or foreseen future, because of an inefficient water allocation or pollution, over time and across users (EEA, 2013).

Several Authors agree that applying FCR would increase the water users payments, mainly to agriculture that currently pays part of the financial costs (Berbel and Gomez-Limon, 2000; Massarutto, 2007; Berbel et al., 2011; Giannakis et al., 2016). According to EEA (2013) *volumetric water tariffs* of Italian agriculture are in the range of 0.04–0.25 €/m^3,.[3] over 0.002–0.70 €/m^3 in a selected group of European countries; *flat rates* are in the range of 30–150 €/ha, over 30–210 €/ha for those same countries. Arcadis (2012) estimate that those charges generate a 50% financial cost recovery rate, as average of 50–80% in the North, and 20–30% in Southern Italy. Massarutto (2003) mentions analogous levels of partial recovery of the total cost. He also highlights the complexity of this computation, warning that in many facilities the final cost value depends on the joint use in multiple uses, as the hydropower generation in Northern Italy, and public water supply companies in South[4] The Author also reports that Operation and Maintenance costs are recovered at 70–100% in Northern Italy, and 20–100% in the South.

Related to FCR, another relevant issue concerns the pricing system that can encourage efficient use of water. *Volumetric* is considered as the most suitable pricing for achieving the WFD objectives (Gómez Limón and Riesgo, 2004; Bartolini et al., 2007; Gallego-Ayala, 2012). Yet, many constraints are found to possibly hinder the reaching of efficiency in irrigation water (Johansson et al., 2002). Massarutto (2007) stresses that recovery should only consider costs incurred by an efficient service supplier that pays all inputs at their marginal cost (MC). Furthermore, Dono et al. (2013) highlight that MC pricing may not allow FCR when average costs (AC) are decreasing, as in large canal schemes, being MC lower than AC. Other factors, such as scarcity due to climate change, may reduce the use of water at levels where MC of running collective facilities is below AC. In conditions of structurally decreasing irrigation AC, or under-utilized irrigation schemes, FCR pricing would charge farmers for inefficient levels of use that do not depend on their choices.

Finally, and key for this paper, WFD provides that Member States may balance negative effects of FCR on social, environmental and economic issues. Other objectives of national policies can be reconciled in WFD, as adequacy of revenues from water services, equity and flexibility, environmental protection, administrative simplicity and transparency (Garcia and Reynaud, 2004; Reynaud, 2016). Cooper et al. (2014) point out that these objectives might be in conflict with each other,[5] and is likely hard to reconcile all in a single policy. Dono et al. (2010) stress that FCR of water services achieved by increasing payments could hinder water protection, encouraging farmers to use alternative sources as groundwater or rivers. According to Reynaud (2016) the implementation of FCR would result in major changes in water use of households (in Italy among other countries), as well as in accessibility issues, since (not Italian) families in the lowest income decile will have to devote major shares of their income to pay the new water bills and wastewater. Moreover, inconsistent aspects are present: Garrido and Llamas (2009) point out that specify the resource cost would require functioning water markets; yet, if this trade becomes a usual practice, there will be no need to integrate the resource element in the water costs. In any case, according to Howarth (2009) a critical aspect is that WFD, and the documents on its application, are vague in defining the criteria to assess these issues. Gómez-limón and Martin-Ortega (2013) stress that the vagueness of Article 9, can also lead to conclude that it is not required to apply increases in water tariffs. Also because of this vagueness, many river basin plans are mainly descriptive and devoid of prospective analysis. Hence, it would be useful strengthening their economic section to avoid that their choices appear arbitrary in tempering the social impact of FCR, and in protecting environmental quality.

[1] A key factor of delay is considered the lack of adequate metering systems, a precondition to present users the water costs.

[2] The RIBs are non-profit landowners associations with legal status.

[3] Arcadis (2012) report 0.03-0.07 €/m^3 as the prevalent range for *volumetric* pricing in Southern Italy.

[4] Depreciation and capital cost depend on accounting practices, on allocation of assets ownership and economic risk among operators, users, and public authorities (and among types of uses for multipurpose water systems) (EEA, 2013).

[5] Achieve economic efficiency may conflict with ensure adequacy of revenues, both may conflict with reaching of equity.