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Full Cost Recovery Principle of Water Use at River Basin Level: A Literature Review

PROJECT REPORT

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Introduction

Under-pricing or lack of full pricing of irrigation water is considered a major cause of low water use efficiency (WUE). Farmers are usually price responsive in their use of irrigation water and an increase in price could lead to the use of less water on a given crop and adoption of more water conserving/ efficient technologies (Rosegrant and Ringler, 1998). Monetary means of improving WUE involve different measures ranging from area pricing (partial or full cost recovery), water-related inputs taxes or subsidies, output pricing, volumetric water pricing, to the development of water market for facilitating water trading at regional and inter-sectoral level.

Irrigation water has long been considered a public good, which is provided to the public at a nominal price. It is only in recent years that charging a fee for irrigation water with an aim of covering system operation and maintenance cost, or for recovering a portion of the initial investment, has received some attention. Also, only recently management of water as an economic good emerged in international forums (Briscoe, 1996), and is being implemented in various countries. As an economic good, users can be signaled regarding the value of water through a variety of incentives, including pricing. Here one has to distinguish between pricing aimed at signaling the opportunity cost associated with the use of water (e.g., volumetric pricing based on the marginal value or opportunity cost of water), and pricing aimed at achieving financial sustainability of the water service (e.g., flat rate or output pricing based on the cost recovery approach).

The irrigation sector is the largest user of global water resources. Commonly, capital investments are needed to move water from the natural water bodies to the irrigation fields. The long-term development and building of irrigation projects may require that governments plan, finance and implement them. In many cases, government agencies also get involved in running and managing the irrigation schemes. Tariffs are charged only when the scheme becomes operative, although provisions are made to recoup part of the financial and amortization costs and cover the entire operation and maintenance costs.

When water is taken from aquifers, most or all capital is privately provided by the farmers themselves or by small-scale collective organisations. In this situation, there are often no water prices or tariffs. In the EU, some countries have imposed water tariffs for groundwater, including France, the Netherlands, Denmark, and England and Wales. When groundwater has been used unsustainably by farmers, very few agencies have resorted to use tariffs as use deterrents and most have established quotas, caps or zonification.

This means that irrigation water pricing, as a contentious policy issue, is primarily focused on surface water and where infrastructures have been built to convey water from the source to the fields. These infrastructures are privately, publicly or jointly public-private financed. An overwhelming majority of the water pricing experiences focus on the latter two cases.

Review of literature on agricultural water pricing

There have been a number of studies focusing on irrigation water pricing. Molle and Berkoff (2007) compiled a thorough analysis of pricing policies around the world, touching on multiple aspects related to water policy reform primarily in developing countries. A similar encompassing source is Tsur et al. (2004), though this one does not cover EU countries. This section summarizes the major findings about connections of irrigation pricing policies with cost recovery rates, environmental effects, water demand, farm income and productivity. Most studies applied in the EU look also at the combined effects of agricultural and water policies.

Very few works have analyzed the impacts of water pricing, either establishing, reforming or increasing water tariffs. Most conclusions are based on simulation or math programming models (Berbel et al. 2007; Mejias et al. 2004; Bartolini et al. 2007; Semaan et al. 2007; Riesgo and Gómez-Limón 2006; Bazzani et al. 2005). In general, demand models tend to overestimate the income impact of pricing policies and to underestimate the water demand elasticity resulting from the analysis. The reason for this bias may be that most modelling efforts look at short or, at most, medium term responses. However, Molle and Berkoff (2007) provide an extensive and detailed argument for reducing the expectations politicians and analysts should have with respect to irrigation water pricing.

The key objective of a study done by Garrido and Calatrava of OECD (2010) was to provide an empirical study of agricultural water pricing (for irrigation) across EU countries and Mexico where irrigation is important. The authors examined agricultural water price ranges and characteristics, and the extent to which the price paid by irrigators for water recovers operation and maintenance costs and capital costs (i.e. renewal investment and new investment) for water delivery to the farm (i.e. full supply costs). Water pricing can go beyond full supply recovery rates and charge physical consumption of water resources, as a means to ensure more efficient use (i.e. full cost recovery).

Cost recovery

WFD supports the achievement of economic objectives, specifically full cost recovery for water services, including environmental and resource cost within each of the three sectors: agriculture, industry and domestic. WFD bases the concept of cost recovery on the concept of 'water services,' and the complete meaning of this sentence has been defined in detail in the WATECO guide (EC, 2003) that develops the concept of cost recovery by stating two levels of recovery: 'financial' (*i.e.* full supply costs) and 'environmental and resource' costs (*i.e.* full cost recovery).

The concept of 'water services' is defined in monetary terms as the economic cost of building and maintaining infrastructures and supplying water. This analysis should be done for the agriculture, industry and domestic urban water sectors. Additionally, on top of these monetary costs, WFD requires the estimation of both environmental and resource costs, and the definition of a programme to recover them. Differences between 'environmental cost' and 'resource cost' are difficult to implement in the real world. It would have probably been more useful to separate 'monetary' (O&M, depreciation, financial) and 'non-monetary' (environmental and resource) costs.

Resource costs are the most difficult to quantify. Usual notions of resource costs associate them with opportunity costs that are equivalent to the economic value of the opportunities forgone when allocating the resource to a given user. When water markets exist, resource costs can be assimilated to the market price of water netted of the costs incurred abstracting or moving the water to its final destiny.

The difficulties of separating cost items are related to the different definitions of 'full-cost recovery' prices that each country appears to follow. Appropriate policy action should also recognize that an irrigator's water use may entail additional social costs. These social costs may or may not be included in the definition of 'full-cost recovery' rates, but it would certainly be in the interests of society to identify them and attempt to reduce them. The following sections clarify these notions and provide cost evaluations found in the literature and recent reports. We will use the following typology for monetary costs: a) Private Farmer Costs, b) Irrigation Scheme Costs and c) Public Water Authority Costs.

Private (on-farm) costs

Private irrigation costs include those items for which the irrigator is entirely responsible, and that farmers generally pay as any other farm and cultivation costs, such as maintenance, energy and labour. There are two main drivers for the increased area under precision irrigation (drip irrigation): the scarcity of water and the scarcity of labour, which make automatic irrigation systems very attractive for farmers who face the rising cost of both inputs. In the EU, as one gets to Northern latitudes, waterways are commonly accessible to farmers who can easily pump water out for supplemental irrigation. In these cases, as well as in groundwater irrigation, all costs are private and borne by the farmers themselves.

Irrigation district or scheme costs

Irrigation districts distribute both surface water and, less frequently, groundwater to individual farmers, and the costs of running and maintaining infrastructure and associated facilities serving a clearly identified set of irrigators are in principle paid by farmers irrespective of the kind of ownership of the district's infrastructure. In practice, there is abundant evidence of better district cost recovery in private associations than in state-run or publicly owned water infrastructure

(OECD, 1999). Most schemes are managed by irrigation districts, which usually are non-profit associations with legal status.

In countries such as Italy, Spain, Portugal, Turkey or Mexico irrigation districts are assigned an instrumental role in water policy implementation and water management. According to the Spanish Water Law, irrigation districts (more than 6,500 *Comunidades de Regantes* are registered, covering 2 Mha) must have their statutes and bylaws approved by the Basin Agencies and perform a number of key tasks in water management. For instance, they collect farmers' charges and levies charged by the Basin Agency and transfer the revenue to the latter. They have also approved procedures to solve conflicts among irrigators, organize irrigation turns and develop and co-finance rehabilitation projects.

User associations in Spain are mostly collective organizations, irrespective of whether they are served with public concessions (either surface water or groundwater) or from private groundwater rights. The French Associations Syndicales Autorisées (ASAs) have similar characteristics although their size is usually very small, while the Sociétés d'Aménagement Rural (SAR) are purely private organizations. In Italy, water user associations are association of landowners with public status (meaning that they are regulated by law and subject to government supervision). In Greece, the cooperative irrigation projects result from the joining of the Local Land Improvement Boards (TOEV) and the National Land Improvement General Boards (GOEV), being the former the responsible of running the collective irrigation schemes.

Running costs of irrigation districts are borne solely by the irrigators. However, in most countries, investment costs, either in new schemes or in modernization or rehabilitation projects, receive significant subsidies. Most large irrigation infrastructures across OEDC countries, irrespective of when they became operative, have been built with public capital grants. New irrigation districts are projected to be developed in the next decade in Spain or Portugal, although in the case of Spain, new irrigation projects are now very limited and targeted to areas undergoing depopulation (the so-called 'social irrigation' projects).

Water authority costs

A critical methodological issue regarding cost-recovery analysis is the definition of the financial costs of the services provided by the water government agencies. The situation with regard to cost recovery status may vary for each river basin. Water Authority costs include all cost items directly related to the supply of irrigation water, which are covered by water charges to users and by general taxpayers, with different degrees of cost distribution between the two groups. A common conclusion across countries is that irrigators have been, and still are, heavily subsidized, primarily in terms of insufficient capital cost-recovery.

We should remark that the use of 'marginal' or 'replacement cost' is not assumed in the WFD, and we may recall the water privatization in UK in the 1990s, when the final value of assets was computed neither at 'historical value' (deemed too low a price) nor at 'replacement value' (deemed an excessive price) but estimated based on the 'present value of profit' or, in other words, the ability of buyers to pay. Economic theory defines the capital value of an asset as the present value of the future stream of profit and therefore neither historical value nor replacement value is relevant. In practice, the higher the amount for which the existing assets were sold by the government when the companies were privatized, the higher the charges for water and wastewater required to provide a commercial rate of return on those assets. In contrast, in the case of irrigation, Spain has been given permission by the EU Commission to use historical depreciation criteria for determining the extent of full cost recovery rates.

Groundwater (on-farm) costs

Groundwater is the source of water for 20% to 100% of European irrigated farms, depending on the region and country. Irrigators using groundwater resources apparently pay all financial costs as they pay investment, maintenance and energy costs for pumping water because they are not supplied by any public scheme. Consequently, in most of the countries, users of groundwater do not pay any tariff to water authorities although some countries (France, Netherlands, Denmark and England & Wales) charge a water abstraction fee.

Social and environmental costs

Very few studies have evaluated the environmental, job-market and GNP impacts of establishing tariffs for the use of irrigation water. Non-monetary or social costs caused by irrigation are those inflicted on third parties or on the environment. In both cases, social costs originate from irrigators' use of valuable resources or from polluting the resource base. The former is generally associated with the opportunity cost, and provides an indication of the value of the water allocated to alternative users. Irrigation can affect the environment through its direct impact upon water resources, soils, biodiversity and landscapes, as well as its secondary impacts that arise from the intensification of agricultural production through the transformation of rain-fed land into irrigated land (EC, 2000).

Recent work shows that social costs are far from negligible, and provides a solid basis for urgent policy action. The list of regions or basins where problems related to excessive irrigated water use have been identified would be very long. Generally, resource overdraft is caused by a water demand, both urban and agricultural, quite above the sustainable rate, where the cost paid by users is generally below financial (monetary) recovery cost for surface water and fully or partially paid for groundwater. In south-eastern Spain, where some trading of water occurs especially for fruit, vegetables and greenhouse production, water cost is only around 2% of total cultivation costs. This implies that water demand will inevitably tend to go beyond sustainable renewable use, indicating that the private cost of water does not reflect the scarcity of the resource.

As a consequence of the above-mentioned evidence of irrigation pressure on the environment, countries such as France or the Netherlands try to 'internalize costs' by using an 'ecotax' on water use by irrigators. This ecotax on water abstraction (mostly on groundwater, but also on surface water, e.g. in the case of France) tries to internalize environmental and social costs, but the level of environmental cost recovery is quite low as seen from the first reports presented by the EU member states reporting on WFD implementation. The Spanish government is debating whether to charge an ecotax on all water use (both surface water and groundwater) to contribute to global integrated resource management at the basin level and meet the 2010 deadline set by the WFD for implementation of measures including water pricing. Provisional estimates for this ecotax (EUR

1.00/1000 m3) make it a ‘political contribution of users’ rather than an environmental cost recovery charge.

The use of water pricing incentives such as the ecotax is opposed by some authors as Martinez and Albiac (2004) who show that nitrogen pollution is most efficiently abated by targeting either the source or the emissions, and very inefficiently by imposing levies on used water. Nevertheless, most models of irrigation water demand predict a significant reduction when a water tariff is imposed (e.g. 0.06 /m3 in Aragon, Spain, reduces water demand by 50%). This suggests that water and environmental policies must be closely linked and target the most pressing problems, be it water scarcity or nitrogen pollution. Still a further effort of empirical studies is required considering both short- and long-term farmer responses. In another paper these authors (Martínez and Albiac, 2006) find that water pricing, as advocated by the Water Framework Directive, is inefficient as a pollution abatement tool, and differentiating control measures by soil type enhances welfare, although welfare gains may be small.

Riesgo and Gómez-Limón (2006) concluded about the usefulness of a low water tariff (for example, 0.02 EUR/m3) that favours the implementation of the WFD environmental objectives (efficient water allocation and improvement of water ecosystems). In spite of the negative impacts caused by water pricing, therefore, a low price on water might still be regarded as necessary in order to make farmers conscious of the actual value of water to society, and the importance of using it properly. However, these authors conclude that water pricing should be developed in any case within a wider policy framework led by the CAP, which should attempt to avoid serious negative impacts on irrigated farming and guarantee the survival of rural areas (by minimizing falls in farmers’ income and the demand for agricultural labour).

The definition and components of the costs of supplying water for irrigation

There is no agreement in setting common criterion to define and evaluate irrigation cost items. In this section, we review two approaches: the EU’s WFD and that by Malik (2008). The WFD distinguishes between financial, environmental and resource costs of water services. *Water services* are defined as “all services, which provide, for households, public institutions or any economic activity: (a) Abstraction, impoundment, storage, treatment and distribution of surface water or groundwater, (b) Wastewater collection and treatment facilities, which subsequently discharge into surface water." (Art.2, definition 38). Water use means water services together with any other activity having a significant impact on the status of water. Note that the difference is subtle and crucial, not because pricing principles should be applied differently, but because pricing policies should be applied with regard to and compared to the service costs. In general, water users encompass water service beneficiaries. Irrigation is, of course, a water service beneficiary, but agriculture in general may be a water user. This report focuses only on irrigation as a water service beneficiary.

The WFD identifies three categories of irrigation costs (EC, 2003) (see figure 1):

- Financial costs (*i.e.* full supply costs): Include the costs of providing and administering these services. They include all operation and maintenance costs, and capital costs (principal and interest payment), and return on equity where appropriate).
- Resource costs: Represents the costs of foregone opportunities which other uses suffer due to the depletion of the resource beyond its natural rate of recharge or recovery (e.g. linked to the over-abstraction of groundwater).
- Environmental costs: Represent the costs of damage that water uses impose on the environment and ecosystems and those who use the environment (e.g. a reduction in the ecological quality of aquatic ecosystems or the salinisation and degradation of productive soils).

Methodologies to evaluate capital costs

There are numerous ways to define and evaluate the capital costs of irrigation infrastructure. In the case of the EU, there the Wateco guidelines (EC, 2003) define three categories:

- New investments. Cost of new investment expenditures and associated costs (e.g. site preparation costs, start-up costs and legal fees). In the case of projections, cost of capital should be expressed in Annual Equivalent Cost, using a standard annualization method.
- Depreciation. Annualized cost of replacing existing assets in future. However, guidelines offer a choice of several methods to value of existing assets:

− **Historical value**: assets evaluated at the price they were originally purchased. Because of inflation, this value often bears no relation with what it would actually cost today to replace those assets.

− C**urrent value** is the historical value multiplied by an inflation index.

− **Replacement value** method estimates the present value of an asset from the current cost of replacing it for an identical service level.

• Opportunity cost of capital, i.e. an estimate of the rate of return that can be earned on alternative investments. Although guidelines find acceptable the use of non-private expected rates of return, they recommend that a non-zero rate should be use. Capital subsidies must be taken into account.

Conclusion and recommendations

In the future, there is a need for reforming Uzbekistan's water pricing and financing policies towards full cost recovery, including the pricing of water for agriculture. Clear definitions of irrigation water costs and methodologies to estimate irrigation water costs and cost recovery rates, however, need to be detailed by the relevant government ministries and agencies. Here, the European Commission Wateco Guidelines can serve as a reference. In practice, there are still significant difficulties in (a) collecting the adequate data at the lowest possible scale; (b) applying proper capital cost evaluation techniques; (c) evaluating the resource and environmental costs, in a way that can be officially integrated in the water tariffs; and (d) performing comparative analyses across regions' tariffs and cost-recovery rates. More data sources and documentation are needed to permit a better diagnosis about the use of pricing instruments, and the use of cost-recovery charges in Uzbekistan.

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For notes