Water policy reforms: pricing water, cost recovery, water demand and impact on agriculture. Lessons from the Mediterranean experience.

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Water Pricing Seminar (June 30 – July 2, 2003)
Agencia Catalana del Agua & World bank Institute
Parallel session C : The impact of cost recovery on Agriculture

1 Introduction

Mediterranean countries invested heavily in irrigation schemes to secure and increase agriculture water supply in order to develop this economic sector, to improve food security and to target populations in less favoured rural areas. The State made water available at a low cost to farmers through public financing. This policy resulted in a highly subsidised irrigated agriculture (Abu-Zeid, 2001) where low water prices contributed to irrigated area extension, agricultural water demand increase, and misallocation of the resource among users and uses. Low cost recovery and poor maintenance caused infrastructure deterioration and low water distribution efficiency and irrigation performance. Past policies reached their limits to ensure adequate financial balance and to control water demand. Governments have been compelled to revisit their policies and engage in pricing reforms to improve cost recovery and more recently to shift to water demand management policies - 1997 Fréjus and 2002 Fiuggi conferences on demand-based management (Chohin-Kuper, Rieu & Montginoul, 2002). The objective of the article is to analyse the impact of pricing reforms on cost recovery and farmers revenues and draw lessons from Mediterranean experiences. In the first part, we review water policies and pricing experiences in Mediterranean countries for irrigation water. We then analyse their impact in terms of cost recovery of water services, water demand and farmers revenues (part 2). Finally, we analyse the key factors for water policy implementation.

2 Country experiences in irrigation water pricing

2.1 Analysing water pricing systems

The economic tools used in the agricultural sector to manage water demand are analysed according to two criteria: **the pricing structure and the price level**. A pricing system based on volume or volumetric pricing, which should in theory be an incentive to water saving, will only be effective at a price level to which the user is sensitive. This price level depends on numerous factors: costs of water service, irrigation techniques and the added value of the agricultural products.

The extreme case, where structure is of little importance, is where water is free (Egypt and Albania), which does not encourage water saving at all. At the opposite extreme, Israel has introduced a pricing structure giving high incentive to save water with an increasing block rate pricing structure. Between these two situations, a wide range of tools is used (in increasing order of effectiveness): area pricing system; area pricing system depending on the crop being irrigated or other criteria; a uniform or two-part volumetric pricing system; or an increasing block rate pricing system (Table 1).

The area pricing -flat rate per hectare- (Table 1) as often applied for gravity-fed systems (Spain, Greece, Italy, etc.), may well influence the decision whether to use irrigation but not the quantity of water applied per hectare. But, combined with a very low price and subsidies for the irrigated crop, this type of pricing system has rather encouraged the extension of irrigated areas and the increase of

the demand for agricultural water in those countries. This is the form most commonly encountered when making improvements so as to encourage farmers to take up irrigation.

The area pricing system, modified according to the crop or irrigation techniques, does not encourage water saving for a given choice of crop or irrigation technique, but it does have more effect than the area pricing system on the choice of which crops to irrigate or which irrigation technique to adopt. It can be used to discourage the irrigation of certain crops for example, by applying a higher price to crops that consume a large volume of water (such as maize or tomatoes in Turkey for example).

In the end, volumetric pricing methods are the only ones to actually encourage water saving. A pricing system in progressive blocks, where the price of water increases according to the volume consumed, can have a really dissuasive effect on the consumption of water depending on the progression of the prices and their level, but it is seldom applied to irrigation (Israel, Jordan). However, the price level determines the effectiveness of the pricing system implemented. The price of water applied by SARs ("Sociétés d'Aménagement Rural") in France, although volumetric, may be more effective than the block rate pricing system applied in Jordan on account of a higher average price.

Table 1: Structure of agricultural pricing systems and price levels

Price structure	**Country**	**Price**		**Additional measures**	**Incentive to save water**
		US$/ha	**US$/m³**		
Free	Egypt Albania				None
Area pricing (per ha)	France Greece Spain Lebanon	136 95-220 40-250 285			Low
area pricing depending on crop	Turkey (and by region) Italy (and by type of soil)	20-100 30-250			Low
Volumetric uniform	Spain (rare) Morocco (part) Tunisia (part) Cyprus France (ASA) France (SAR)		0.03-0.08* 0.02-0.05 0.09 0.12 0.06-0.07 0.06-0.3*	 Quotas possible Quotas possible	Low Low Low Moderate Moderate Moderate to high
Optional	France (SAR)	40 or 25	0.07 or 0.17	Optional tarifs	Moderate
Increasing Block pricing	Jordan Israel		0.03 0.13	 Quotas	Moderate Moderate, High within the limits of the quota

Notes: * only the volumetric component of a two-part tariff
Sources: adapted from (ONEP, 1997, El-Naser, 1999, Lacroix, 1999, Plan Bleu, 1999, Burak, 2000, Commission Européenne, 2000, Ghini, 2000, ICTAF, 2000, Kallis & Coccossis, 2000, Ostojic & Lusic, 2000, Limam, 2001, Durand, Fonseca & Karma, 2002)

When the pressure of demand on water resources is high and competition exists between uses of water, quota systems are generally imposed on agriculture. They then coexist alongside a pricing system whose only objective is to pay for the services of the water provider and possibly for the water itself. Quotas guarantees a limit to consumption which will not be exceeded, at least if the penalties and the regulations ensure that it is followed (France, Neste).

However it does not in general encourage water saving within the limits of the quota unless there is particular provision. This is because the user tends to use up all of his quota, and is even encouraged to in those cases where failure to use all of the quota can lead to it being lowered the following year

(Israel). On the other hand, the option of carrying the unused quota forward into the following year (France, Beauce) can help to remove this negative effect by placing a limit on overall consumption but at the same time encouraging water saving.

2.2 Taking the scarcity of the resource and the environment into account

Recent changes, in particular at the European level with the Water Framework Directive[1] (European Communities, 2000), imply that the scarcity of the resource and the environmental aspects are taken into account when using economic tools. This means setting up new institutions (such as a water agency in Morocco), or technical and economic instruments (based on the polluter-pays or consumer-pays principle). Thus, a water tax for irrigation water is charged in several countries – France, Spain and Italy – but the levels of fee remain very low (Chohin-Kuper, Rieu & Montginoul, 2002). In France, although a draft law on water proposes an increase in taxes, the incentive to save water remains weak (Chohin-Kuper, Gleyses, Rieu & Tauber, 2001). In Italy, taxes for drawing water even fell in real terms between 1993 and 1994. Other countries like Greece levy no fees. In Jordan, a tax has been introduced to control the over-exploitation of groundwater.

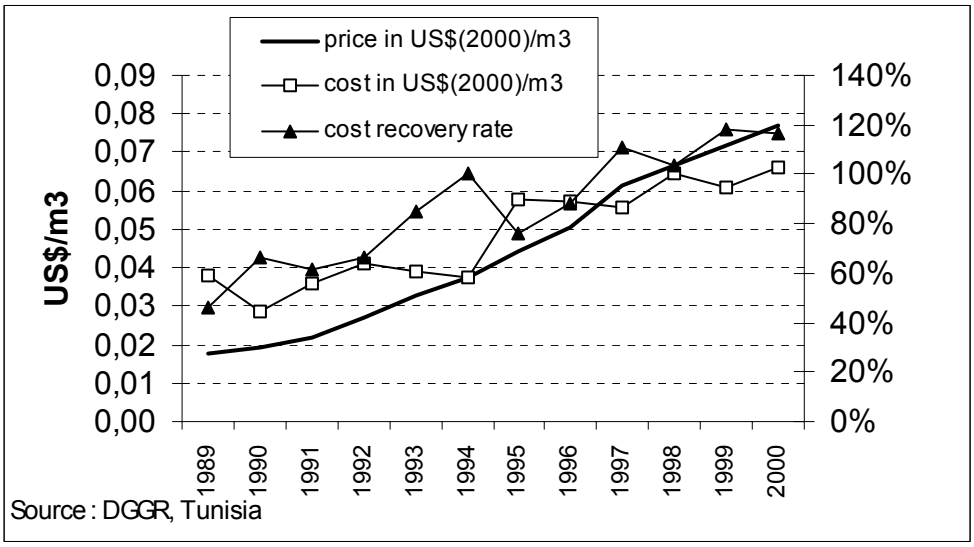
3 Water pricing impacts and consequences

The analysis of impacts of economic tools is based on theoretical and case studies. But concrete case studies where water prices vary within in a large rank are very rare around the world. One of these is Tunisia where the national water policy implemented irrigation price increases for a rather long period (since 1989).

3.1 Planned increases in the price of water improve cost recovery

Certain countries applying volumetric pricing systems are planning to increase prices (Tunisia, Morocco). In Tunisia, the regular increase in the price of irrigation water since the mid-1980s has been 12% a year in nominal terms (or about 6% in real terms) (Dinar & Subramanian, 1997, Belhaj Jrad, 2000). This has enabled the Tunisians to recover operation and maintenance costs (Figure 1) (Belhaj Jrad, 2002).

Figure 1: Changes in the price of irrigation water and rate of cost recovery in Tunisia



[1] « The principle of recovery of the costs of water services, including environmental and resource costs […] should be taken into account in accordance with, in particular, the polluter-pays principle »

In Morocco, the pricing adjustment plan proposed for schemes in financial imbalance should help to improve the covering of the cost of recurrent charges (operation, maintenance and renewal by 2010). The adjustment plan is expected to achieve budget balance within 1 to 6 years for schemes in slight deficit, which represent 40% of irrigated land (Montginoul & Rieu, 2001). On the other hand, in schemes with severe deficit – 12% of land area, where water is lifted to be put under pressure – it should reach a recovery rate of 65 to 80%.

In this case, operation and maintenance costs are fully covered by users through the price of the water service. A large part of capital costs, and by the way of the full financial cost, remains to be largely supported by the local authorities. In northern European countries like France, users are supporting a part of capital costs from 20 % to 50% on average.

Other countries have increased or expect to make limited increases, to recover more of the water costs: Cyprus, Lebanon, Israel, Jordan. In Cyprus, an increase of 80% in the price of water by the year 2003 is expected (Chohin-Kuper, Rieu & Montginoul, 2002). The price should then cover 22 to 38% of the average weighted cost, as against only 22% now (Socratous, 2000). A price increase of 20 to 30% is expected in Lebanon.

3.2 Price increases and lowering the water demand

Some experiments on price increases for water show an impact on consumption. In Tunisia, the regular increase in the price of irrigation water, besides other institutional measures, has enabled the water demand to have been stabilised since 1997. Further more, a four-fold increase in the price of irrigation water within the irrigated area of Jebel Ammar in Tunisia (Ariana CRDA) led to a drop in water consumption to a third (Figure 2).

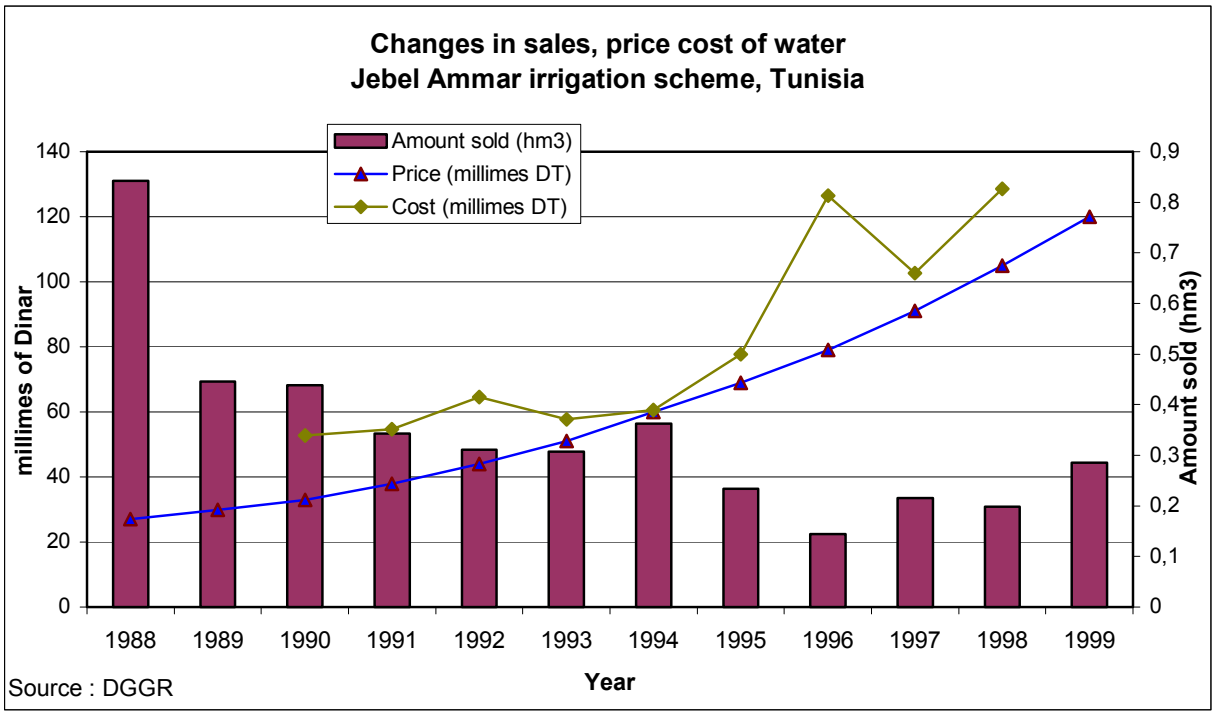


Figure 2: Change in the water demand in response to price increases in Tunisia (source DDGR/ENGREF)

This case study also illustrates that balancing the budget in this context might be difficult and that environmental concerns might occur as an increase in the price of water can lead to the development

of alternative resources, especially to using groundwater as in Morocco and Tunisia ((Bechtel/Scet-Tunisie, 1999).

3.3 Price sensitivity of agricultural revenues to water prices and farmers acceptability of water reforms

As a general feature, prices elasticities in the Mediterranean Region, are rather low and in any case, raising the water prices has a significant impact on farmers revenues.

In the Duero, where the number of possible crops is limited, the demand for water is relatively rigid. Use of the price tool alone does not significantly reduce water consumption on farms (Gomez-Limon & Berbel, 2000). More generally, in Spain, the farmers' incomes would need to fall by 25 to 40% before an increase in the price of water (7 to 14 ptas/m³) would lead to a lowering of water consumption (Berbel & Gomez-Limon, 2000).

In the Charente river basin (Montginoul & Rieu, 2001), pricing water appears to be a convenient instrument for water demand management (figure 3) as an increase in water price lowers significantly the irrigation water use due to high price elasticity of demand. Nevertheless, even the very first increase in prices has a significant impact on farmers' revenues that is unacceptable. This led the local authorities and the water agency to abandon the pricing instrument and shift to a quota system.

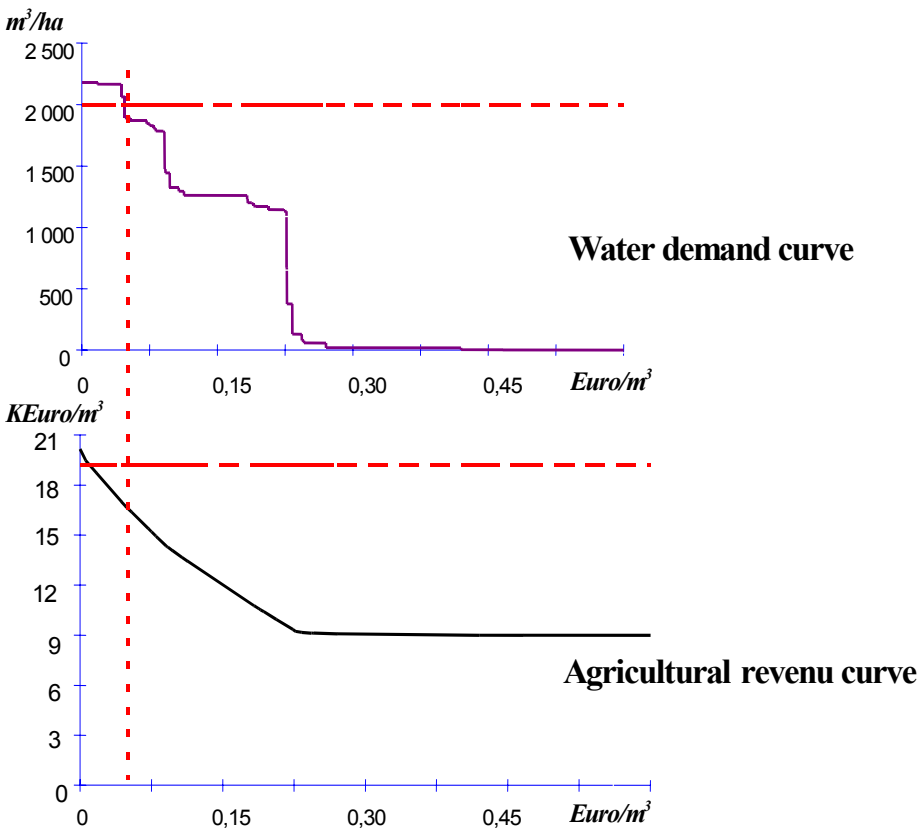


Figure 3: Change in the water demand and farmers revenue in response to price increases (source Cemagref).

Four types of policies can be implemented to address this constraint of acceptability:

- Progressive price reforms: annual price increases so that the rise is no faster than that of technical progress in agriculture, case of Morocco (Belghiti, 2002).

- Limited increases in prices : in Lebanon, the increase in price is limited to what users can pay; in Morocco taxes on electricity are reduced in pressurised irrigated schemes with high budget deficit (Agro-Concept, C.I.D & Scet-Maroc, 1999) where the cost of water would be too high (break even price 0.07 compared to 0.02 US$/m³ in other areas);
- Special pricing structure: a pricing system with bonus for water saving (volumetric pricing and block rate pricing) allows the impact on the farmers' revenues to be lessened while saving the same amount of water (Varela-Ortega, Sumpsi, Garrido, Blanco & Iglesias, 1998) In the region of Valencia in Spain, the drop in income thus changed from 70% to 30% or even 15% with a volumetric pricing system, a volumetric pricing system with bonus and a block rate pricing system with bonus respectively;
- Free supply of water to farmers (Egypt) at the extreme.

4 Key factors for water policy implementation

We showed in the previous section that the implementation of pricing reforms is constrained by their acceptability and the need to guarantee an acceptable income to farmers. We now consider, as key factors, the mechanisms that are at stake to determine price sensitivity of water demand and consider the conjunctive use of other instruments to manage water demand.

4.1 Price sensitivity of demand for agricultural water

Water pricing will not always be a sufficient incentive for users to enhance water use efficiency. That will be the case when price elasticity water demand is close to nil, e.g. when the water bill accounts for only a small proportion of the farmers' total production costs or income; when alternative ways of cropping or water resources are not available, due to technical, social or economic constraints; or when the bulk of the total water charge consists of fixed costs. Beyond these factors influencing the sensitivity of demand for water that are now well documented in the literature (see examples below), we come back to the trade-offs farmers face when they decide to irrigate or not. Three levels of decision can be distinguished :

1. The decision to invest in irrigation equipment and to have access to water resources. This is a medium term decision between rain fed and irrigated agriculture,
2. The choice of an irrigation cropping pattern with more or less irrigated crops or with crops that are consuming more or less water. Except in perennial crops like orchards, this is a yearly decision,
3. The choice of irrigation practices : irrigation scheduling and level of restriction for the different crops. That is a very short term decision.

The resulting elasticity of water demand depends on the elasticity at each level and is derived from the rigidity of the farming systems that is directly linked to the structural constraints, the financial capability and the time horizon that is to be considered by the farmer. This mechanism determines the magnitude of impact of pricing on water demand and the heterogeneity that could be found within an irrigation scheme. This is well illustrated in the following literature.

A comparison of demand curves for water between various regions of Spain (Arrojo, 1999, Arrojo & Carles) shows very variable elasticity of water demand depending on the existence of alternatives - crops consuming less water and whether extensification is possible - and also on the structure of property. In Jucar and Segura, vegetable and fruit crops with high added value, combined with the small size of farms make the water demand inflexible.

Another study on Spain (Varela-Ortega *et al.*, 1998) gives similar results: when the price of water increases, farmers generally react in the first instance by changing to crops that consume less water then to crops that need no watering, if this is possible. This is the case in Andalusia, a region in which large farms where alternatives are available and with a large production capability predominate. In

Castille, a region where there are small family farms with limited production capability and a limited number of crops, an increase in the price of water leads directly to irrigation being stopped and a change to non-irrigated crops. In Valencia, the very small specialist farms abandon the orchards or choose orchards that consume less water.

4.2 Conjunctive use with other tools and policies

As previously seen, the pricing tool has its limits. In particular, it alone is unable to force users to save water, since in general sensitivity to price is fairly weak and price is not able to convey sufficient information when there is an isolated crisis on the resource. Other tools are used to reinforce it. We have already described in part I cases where water rationing (quotas systems and restrictions by cut in supply) has been set up to respond to situations of structural shortages. They then coexist alongside a pricing system whose only objective is to pay for the services of the water provider and possibly for the water itself.

Other technical and administrative measures are also implemented to encourage water saving :

- Installing metering systems seems to be a factor in reducing the consumption of water , farmers rationalise how plants are watered or change to crops that need less or no water. This is restricted to under pressure distribution systems in irrigation systems where water is distributed by surface works and by gravity, water consumption has to be estimated through time or energy measures (Tunisia, Morocco). It should howeverbe noted that, although the impact of installing meters seems to be progressively accepted when the water law enforces it (France, 1992 water law) the permanence of its effect can be limited in time (familiarity effect: after the first year of effort, the farmers become less vigilant about their level of irrigation),
- In situations where there are structural constraints on the resource, restrictions may be effective in controlling the water demand. For example, in the Charente river basin in France, a management plan defines water restrictions depending on the discharge level in the rivers. In Israel, administrative reductions may be effective in reducing the demand for agricultural water without reducing incomes at all (for example when there is an alternative to irrigated crops in winter) and allowing it to be reallocated to other districts that can use it better (Amir & Fisher, 2000).

Finally, for water management tools to be appliedpolicy design has to take into account other policies and national objectives such as land improvement, reduction of food dependency, policies to prevent rural depopulation and to guarantee sufficient food production. Consistent and coherent policies are a condition for sustainable water management.

5 Conclusion

Pricing experiences in Mediterranean countries are in general oriented towards cost recovery objectives and have contributed to the reduction of public financing at least with respect to operation and maintenance costs of irrigation schemes. More rarely, a part of capital cost is charged to farmers. That would lead to a better durability of water infrastructures.

These pricing policies have a negative impact on farmers revenues which influence pricing policies or need complementary policies addressing the issue of “acceptability”. However, these price increases did not contribute significantly to water demand management objectives and there is a need for complementary tools and policies in order to tackle the water resource issue.

Finally, the impact of water pricing reforms on conjunctive use of alternative water resources and its potential impact on the environment –groundwater depletion, soils salinisation risks- need to be assessed but this has not yet been analysed due to the fact that significant increases in water pricing are still limited to few countries.

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