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Water pricing for agriculture between cost recovery and water conservation : Where do we stand in France ?

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Water pricing for agriculture between cost recovery and water conservation : Where do we stand in France ?

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Abstract :

Based on concrete case studies this communication presents the French experience in water pricing for various regions and irrigated schemes and over time. It shows a large range of ways for charging for water that could be analysed in light of the main objectives that are dedicated to it by policymakers and water managers : cost recovery, income redistribution among users and water conservation. This last issue will give us the opportunity to discuss the incentives to save water they provide in order to evaluate the consistency of these economic instruments with the European Water Framework Directive.

Keywords : water pricing, irrigation management, water savings, quotas.

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Introduction

The last few years have recorded an increase in competition over water resources in France as in many parts of the world – competition over quantities of water, its quality or the ecological status of water ecosystems. In response to this, the Water Framework Directive[1] (European Communities, 2000), and consequently the next French water law, are taking into account scarcity and the environmental aspects. In particular the annex 9 of the WFD recommends the setting up of economic instruments, based on the polluter-pays principle in order to insure incentive pricing to water savings and "adequate" cost recovery . By the way this European directive is the first one to recommend the implementation of economic principles.

When looking at the economic instruments that are in question, the incentive to save water remains weak as the level for water abstraction fees remains low and water pricing is often designed to reach budget , even in the Mediterranean countries (Chohin-Kuper, 2002) where pressure on water is high. In France, although a draft law on water proposes an increase in taxes, a drastic change in water pricing is not really expected. This is somewhat contradictory with the present French water law of the 3 January 1992 whose main objective is to ensure the protection of water quality and quantity and aquatic ecosystems.

Based on selected case studies this communication presents the French experience in pricing water for agriculture in various irrigated schemes over time. Considering that pricing results are from a trade-off between water demand and supply, the first economic instruments to be analysed will be those that are

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

built from a cost recovery perspective and in the second section those that are derived from the demand side. The large range for charging for water that can be analysed is seen in light of the main objectives for policymakers and water managers including cost recovery, income redistribution among users and water conservation. Finally, the evolution of tariffs over time will be addressed in order to show the close relation between the management's objectives and the choice of a tariff. Some recommendations will be then derived.

The French context

In order to give an overview of a pricing system in a given country, two main elements have to be described: the legal framework that defines the range of instruments that can be implemented and, secondly, the main characteristics of water resources and its use. Information about the farming systems and their heterogeneity in terms of access to water will also be crucial in order to evaluate what would be the impacts of a change in tariffs and pricing.

The legal framework

In France the main legal framework is represented by the law of January 1992 on water management. Its main objective is to protect water resources and the aquatic environment and to value water as an economic good. Since this law, all waters and aquatic ecosystems have become 'national' heritage' (–patrimoine commun de la nation-) and it provides communities and institutions with the tool to reach comprehensive water resources management. This means that water belongs to nobody including the state itself. Water rights are not defined and this is the reason why water markets are not encountered in France. In practice the water policy service allocate annual allowances for water withdrawals. Only some informal transactions on use of water have been heard

This law also sets priorities between the various uses : conservation for aquatic ecosystems through the enforcement of minimum summer flows in the rivers, drinking water and finally economic use which includes irrigation. Furthermore theses issues will be reinforced by the WFD that emphasises on both the "adequate" cost recovery and the setting of water pricing that are incentives for water savings.

Irrigation in France

During the last decade irrigation has been growing quite steadily from 1.1 million hectares of irrigated crops in 1988 to 1.6 million hectares in 2000. Such an increase is mainly explained by the development of irrigated maize and wheat whose water valuation is weak compared to those of other main irrigated crops (industrial crops, fruits and vegetables). This development depends heavily on the crop market conditions and on financial support coming from the EC through the Common Agricultural Policy.

Table 1 : Evolution of irrigated areas (ha) from 1970 to 2000

	1970	*1979*	*1988*	*2000*
Irrigated area (ha)	538 537	800 533	1 146 988	1 575 625
Potential irrigated area (ha)	767 200	1 325 227	1 796 769	2 633 682

(Source : Service Central des Etudes et Enquêtes Statistiques – recensement agricole, 1970, 1979, 1988, 2000)

From table 1, we can see this increase mainly concerns farmers that have an individual access to surface water or groundwater and that they are located in the following regions : South West, Atlantic coast, Centre and Alsace Plain, where large hydraulic infrastructures have not been built to increase the water supply for the peak season and where irrigation needs are stochastic as irrigation is only a complement to rain. Furthermore, these individual withdrawals that are made in rivers and aquifers, imply often water conflicts between agriculture and environment during the summer period when river flows are low or between agriculture and other uses such as drinking water, when the aquifers are overexploited.

In order to regulate individual access to water resources and taking into account the difficulty of the enforcement of legal rules (Flory, 2003), the only economic instrument in place is tax on water withdrawal by the basin agencies following the polluter-payer principle. Charges are derived from the withdrawn water volume or lump sums on the basis of the irrigated surface when no metering system has been yet installed. Through these charges users internalise some of the negative impacts on environment and third parties are provoked. But, the low level of these charges compared to the cost of water (individual or collective) services, implies they don't have any incentive save water (table 2).

Table 2 Water basin Authorities : Abstraction charges for irrigation.

Water basin Authorities	*Average tax (2002, €/m3)*	*Minimum & maximum taxes amount (2003-2006, €/m3)*	*Abstracted volume (millions m3, 2002)*
Adour Garonne	0.0047	0.0026 – 0.0057	758
Artois Picardie	0.0134	0.0120 – 0.0609	15
Loire Bretagne	0.0066	0.0044 – 0.0175	495
Rhin Meuse	0.0014	0.0013 – 0.0015	77
Rhone Méditerranée	0.0015	0 – 0.0027	1643
Seine Normandie	0.0171	0.0051 – 0.0192	95

Source : Agences de l'Eau.

As these individual water services are not, by definition, subject to any charge, except the charges we see in table 2, or in very specific conditions where water is withdrawn from a resupplied river, this paper addresses collective services for irrigation that are managed through dedicated institutions like water user associations called -Associations Syndicales Autorisées d'irrigation (ASA)- and regional water companies called -Sociétés d'Aménagement Régional (SAR)-. We should notice that there is an increasing number of farmers who have both individual and collective access to water through wells that are drilled in large collective schemes. This phenomenon is recognised all over the world (Shah, 2000) and has had a number of (negative) consequences for the design of water charging in irrigated schemes. Furthermore, conflict around water are less frequent in those collective irrigation systems than in basins where irrigation has been developed on an individual basis. The new water law is supposed to lower the charges for those who are in collective systems.

Table 3. Access to water in France.

Access to water resource	*Irrigated acreage (ha)*	*acreage (%)*
Collective	371 137	23.6
Individual	887 912	56.4
Both collective and individual	316 577	20.0
Total	**1 575 616**	**100.0**

Source : Service Central des Etudes et Enquêtes Statistiques – recensement agricole, 2000

Tariffs

Principles :

A water charging system has to be designed in accordance with the general objectives that are defined by the public authority and with the specific objectives of the water service. That means that the manager will be in charge of the design of the pricing system in co-ordination with users and representatives of the agriculture and environment departments. This pricing system is implemented by the water service manager. In France, the charging system is merged within a legal framework, ie mainly the water law and now the WFD. The main objectives to be reached are the following :

- balance the budget in order to maintain a good quality of service and to ensure the sustainability of hydraulic infrastructures,
- provide users information about water scarcity through its price and avoid wastage,
- support the agricultural sector through local subsidies and the consent of the farmers. The normal way for reaching this is to negotiate and obtain public support from national or local authorities, for the investments linked to large infrastructures (dams, canals, pumping stations).

As a result price is discussed between 3 main actors : the state (including the basin agency), the project manager and representatives of farmers (Tardieu,2000). The outcome of this negotiation process, that is frequently bilateral, is a design from the demand side or the supply side; ie what the users are willing to pay. The main pricing structure in France is established along these lines even though in reality supply and demand are combined.

Supply

The price of water is derived normally from the cost , namely for projects that are managed by water users associations. Using an average cost is the usual way to establish the rate of subsidy for an investment for public and /or local authorities. From the total financial cost and the life duration of the infrastructure, an annual average cost per hectare is derived and compared to the willingness to pay from farmers, taking into account cropping patterns and some market conditions. Secondly, the water users association keeps this rationale of average cost and defines a water price in light of the different situations. This type of pricing is really easy to understand and to present to the members.

Average cost

A recent study from Cemagref (Gleyses, 2004) for the department of Environment dealing with water tariffs in the Charentes river basin provides an in depth and up to date overview. On the basis of a sample of 75 associations, the average price is estimated to 0.11 € per m3 with a confidence interval at 95% ranging from 0.09 to 0.12 €/m3. Tariffs (table 4) are mainly binomial with a fixed part based either on the irrigated acreage or the subscribed flow and with a variable part proportional to the water volume. Flat tariffs are mainly based on the irrigated acreage.

Table 4 : Water pricing for collective irrigation schemes in the Charente river basin.

Water pricing structure	*fixed (€)*	*variable (€/m3)*	*Size of association members questioned*
Binomial (Irrig. acreage, Vol.)	81	0.06	33
Binomiale (Flow, Vol.)	38	0.06	8
Lump sum (Irrig. acreage)	198	-	23
Monomial (Vol.)	-	0.10	11

Source : Cemagref, 2004.

The most remarkable point is that despite the breakdown of water tariffs, the average price is quite homogenous. This reinforces the previous hypothesis of setting water price with the consideration of water value that is derived from the irrigation of the common crop, maize and this evens out the financial support for investment.

Marginal cost

Marginal costing for water supply derives from the Pareto's optimum. According to this principle, it ensures efficient water allocation and avoids economic distortions. If we consider a large regional water service, a monopoly and it balances its budget, it brings us to Ramsey-Boiteux water pricing method. This type of tariff is used by the Regional development Company SCP –Société du canal de Provence- located in the South East of France. This tariff has been designed as a long term marginal cost pricing (Jean, 2001) as the hydraulic works have been built over several decades. The company supplies raw water to a diversified panel of uses from irrigation to drinking and industrial water.

For the implementation of these water pricing principles, SCP defines what is called the "development cost" as follows. It is the sum of :

- Cost related to building new infrastructure (dams, canals and main distribution works) to satisfy an additional unit of water demand when works are beyond capacity,
- Proportional cost including the value of water and operational costs (energy, wages ...).

Finally, the total cost depends on the discounting rate used for the investments and on estimation of the date when demand will meet the available water resources. This means that this approach is not only based on supply analysis but also takes into consideration the demand side.
What is more interesting is the way this economic analysis is used: this tarification is considered as a reference for negotiation by the stakeholders. For each use, the output is a price defined as a rate applied to the long term marginal cost. Social considerations and the economic situation forecast for the next period are main arguments in the negotiation process.

Table 5. SCP water tariffs.

	Upstream command area	*Intermediate Command area*	*Coastal Command area*
Fixed part (€ per m3/h)	14	12	9
Variable part (€/m3)	0.09	0.07	0.04

Source : Association Française d'Etude des Irrigations et du Drainage, 2001.

For all uses excepted irrigation, pricing is trinomial with (i) a fixed part depending on the maximum subscribed flow, (ii) a volumetric part depending both on the consumption in the peak period (4 months in the summer period) and outside the peak period. For irrigation, this mainly occurs in summer, the water pricing is, as a consequence, binomial. Some specific tariffs are offered for protection against frost, or when SCP has to deliver water at a higher pressure than the nominal one.

Demand

Price sensitivity and the demand for agricultural water

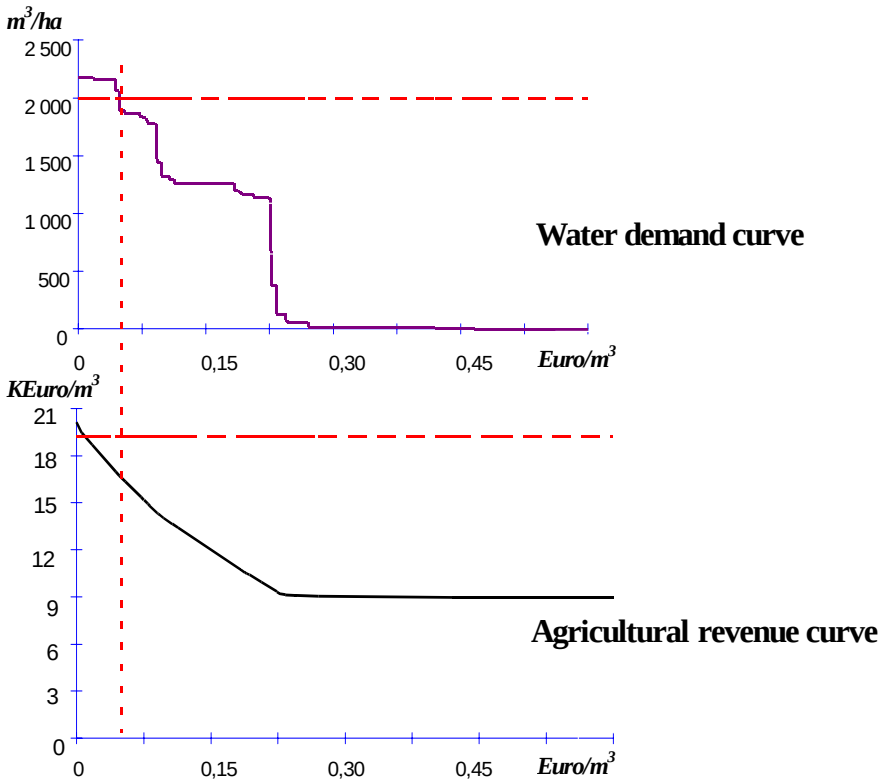
Water pricing will not always be a sufficient incentive for users to enhance water use efficiency. This is the case when price elasticity for water demand is close to nil, e.g. when the water bill accounts for only a small proportion of the farmers' total production costs or income; when alternative ways growing crops 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 which have been well documented in the literature, we come back to the trade-off position where farmers are faced with the decision to irrigate or not. Three levels of decision-making 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 rainfed 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. This 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 are directly linked to the structural constraints such as the financial potential 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.

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 which is unacceptable. This led the local authorities and the water agency to abandon the pricing instrument and shift to a quota system.

Figure 1. Water demand and farmers revenue in Charentes river basin (France).



Source Cemagref

Towards a balanced budget

In many situations the first objective of the water manager is to balance its budget through water pricing. This is particularly true when there large hydraulic works that induce high fixed costs as they have been designed to meet long term water demands. The implementation of the Water Framework Directive and the cost recovery principle could make this situation more frequent depending on the interpretation of the term "adequate cost recovery".

In these conditions and when water valuation among farmers is more heterogeneous, a menu of optional tariffs can be proposed to users in order that the rent extracted by the manager from users could be maximised (Chohin, et alii). Farmers with low water elasticity of demand to price will be offered a higher price, and inversely.. This type of pricing is intended to increase the manager's revenue and to ensure the various users an adapted quality of service. This situation can be illustrated through the case of BRL.

BRL – company for the development of the Languedoc Roussillon Region- (South East of France) is a Regional development Company (SAR), i.e. a commercial company with a majority of public shareholders, run under the special control of the Agriculture Department. Due to the objective to promote the regional development, large hydraulic works have been built and are now largely oversized compared to the present water demand (Nicol, 2001). When a farmer wants to irrigate, they apply for a water contract and have to choose among different tariffs (table 5) that are roughly of the 2 following types :

- Tariff “Pro” : This tariff is aimed at farmers who practice each year a regular irrigation on crops like orchards and vegetables. Tariffs are binomial with (i) a fixed part based on the subscribed flow, that is the maximum instantaneous flow the farmer is allowed to use. This flow is chosen by the farmer according to the characteristics of the plots, cropping pattern and irrigation equipment, and (ii) a proportional part, based on the water volume,
- Tariff “Appoint” : Supplemental tariffs are aimed at farmers who don’t need much water and sometimes not every year. It is well suited for vineyard and some cereals like durum wheat that is a drought resistant crop. The fixed part is lower than for regular irrigation and the proportional part higher, so that if the farmer uses a greater water volume, they will be introduced to an incentive to turn to a regular irrigation contract.

Table 6. BRL Optional water pricing.

	Tarif “Pro”	*Tarif “Appoint”*
Basis	Subscribed flow (m3/h)	Volume (m3)
Fixed part (€ per m3/h)	54	36
Variable part (€/m3)	0.076	0.184

Source : BRL, 2001.

Furthermore, subscription fee, the fixed part of the tariff, varies according to the time duration of the contract (1 year versus 5 years), as an incentive to long term contracts that secure the manager’s revenue. At the same time, farmers with vineyards are reluctant to sign long term contracts because of their low and variable water use. All these prices are indexed on price evolution according to an index representative of BRL’s costs (mainly hydraulic work operations, energy, and wages)

So BRL has not faced any water resources concern during recent droughts and its water pricing system is not designed to promote water savings, although the volume charge is an incentive to avoid any waste of water. Due to concerns of balancing its budget, BRL has proposed contracts that are more closely adapted to the different situations and farmer strategies.

From a general perspective, the design of water pricing systems is generally a compromise between the two approaches : from the demand side versus the supply side and costs. Combining various water pricing structures and being applied in very different situations, a large range of types of tariffs is to be achieved from classical average cost pricing to more sophisticated as a long run marginal cost pricing or optional tariffs. What is important is to be convinced that the toolbox is rich enough that it is certainly possible to find an instrument that will be in accordance with the selected case in question.

Conjunctive use of water pricing and quotas

When the pressure on water resources is high and the available resources are scarce, French water managers are more likely to choose to implement water quotas. This is illustrated by the cases; the Charentes river basin and the Neste canal system. In these cases this instrument is implemented both with a water pricing instrument as charging for water remains essential to cover all the costs needed to maintain the quality of the water service.

The « Neste System » is part of a river basin with upstream dams that resupply rivers from which farmers directly withdraw water for irrigation. CACG -Company for the development of the Coteaux de Gascogne Region- (South West of France) is a Regional development Company (SAR) and has been managing this

system since 1991. In this basin water resources are not able to meet all the demands and the pressure on water resources is high in summer during the low flow period.

In order to be allowed to withdraw water from the resupplied rivers, farmers are able to apply for contracts, called –convention de restitution- with CACG. These contracts allocate quotas among farmers. They subscribe for a volume according the characteristics of their irrigation equipment and plot characteristics. This allocated amount is at maximum 4 000 m3 per l/s with a frequency of 8 years out of 10 and could be lowered by 2 years when drought periods occur. This quota ensures that the total water delivered will not exceed the available volume of the dams and the minimum flow in rivers to be maintained.

A pricing system (table 6) is implemented with 2 objectives: (i) reinforce the quota system by charging the water volumes exceeding the amount of the quota (ii) charge the average supply costs to the users. The design is rather closed to an increased bloc rate tariff.

Table 7. Water pricing of the "Neste canal system".

Basis		*Amount (€, 2005)*
Subscribed flow (l/s)	Fixed part	60*p
Metering fee (l/s)	Fixed part	40*p
Exceeding volumes over the quota (m3)	Volumetric part	.120*p
"p" value (€, 2005)		**0.901**

Source CACG, 2005

These prices are indexed on price evolution according to an index "p" representative of both CACG's (hydraulic works, energy, and wages) and farmer (maize and beef cattle prices) costs. The nature of this index is the result of a negotiation process between representatives of the farmers and CACG.

Historical perspective

When looking at the design of the tariff of an irrigated scheme, it's essential to keep in mind that tariffs – both prices and structure- will evolve greatly over time. In some cases the evolution could be seen as a cycle beginning by an expanding phase due to the political will to demonstrate the utility of the large investment that has been made, the following phase could be a more steady period looking for balancing the budget with higher water prices and finally a mature system where economic instruments and objectives are more consistent and negotiated between the different stakeholders. The historical perspective of the tariffs evolution at BRL (table8) provides such an illustration.

Table 8 : Historic review of BRL's water pricing policies

Period	*Objectives*	*Tariffs / prices[2] €(1960)*	*Impacts*
1960-1965	Balance fixed costs and annual revenue.	Binomial (flow and volume) *21Q(l/s) + 0.006V (m3)*	Low level of contacts subscription and unbalanced budget.
1965-1970	Expand the irrigated acreage	Block rate decreasing (volume) *V < 1500 m3/ha : 0.02V (m3)* *V< 3000 m3/ha : 0.01V (m3)* *V> 3000:ha : 0.008V (m3).*	High increase of irrigated acreage, Earnings highly dependent on climatic conditions, Difficulties to control the real irrigated acreage of farmers.
1970-1993	Balance the budget even in wet years.	Binomial (flow and volume) + free allowance (300 m3 /l/s) 45*Q(l/s) + 0.05V (m3)*	Robust system, Budget more and more unbalanced due to the index formula for price revision don't depend on BRL costs.
1993-2004	Balance the budget and protect against prices evolution.	Binomial (flow and volume) *45Q(l/s) + 0.06V (m3)*	Due to high water prices, irrigated maize disappear in the scheme.

BRL, 2004.

Conclusions :

Pricing experiences in France are first oriented towards cost recovery objectives and have contributed to the reduction of public financing at least with respect to operation and maintenance costs for irrigation schemes. In addition a part of the capital cost, ranging from 60% to 15% is charged to farmers. Is this cost recovery " adequate" ? This has to be restudied again with the implementation of the European Water Framework Directive and the new Common Agricultural Policy in order to ensure the sustainability of water infrastructures. Consequently, a large part of water companies and water users water pricing systems that avoid any waste of water. This characteristic is reinforced by the fact that a lot of them have volumetric or other variable rate systems.

From the diversity of selected cases, we can derive that a water pricing system is always needed even if quotas systems are implemented. Secondly, it makes very little sense to speak about the design of water pricing in general because a tariff has to be defined according to an objective that has to be shared among the main stakeholders. Thirdly, like irrigation tariffs have their own life cycle, a pricing system will evolves over time depending on the economic situation and, once again, the objectives of public authorities and water managers.

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[2] All prices of this table are derived from French Francs from year 1960 with a change rate of 1 € = 6.567 FRF

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