Chapter 8
Water Pricing in France: Toward More Incentives to Conserve Water

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Abstract With an historical overview of the legislative and regulatory framework of water pricing in France, this chapter first describes how the focus of pricing policy progressively shifted from budget balancing to water conservation then to social protection. The next part focuses on pricing practices in the urban sector. Price levels and the evolution of tariff structures are analyzed using surveys and case studies results. The fourth section focuses on water pricing in the agricultural sector at different scales: large public irrigation schemes, smaller water user associations, and individual irrigation systems. The evolution of water abstraction fees collected by river-basin authorities is also analyzed, and we present how these fees can be modulated depending on the degree of collective management of agricultural water resources. To conclude, we discuss the efficiency of water pricing in urban and irrigation sectors and highlight some limits to take into account several uses.

Keywords France • Economic instrument • Economic incentives • Irrigation • Water tax

8.1 Introduction

Like in many regions of Europe, water is increasingly scarce in France, and as water demand goes up, environmental standards incite to let more in rivers' basins, and pollution reduces available resources. Simultaneously, the cost of producing water

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rises, as water has to be transported over longer distances and/or treated at a cost that has been continuously rising over the last two decades—in particular for drinking water, due to the cost of removal of nitrates and pesticides, and the strengthening of quality standards. In response to these changes, water is now clearly perceived as an economic good that should be charged to users in order to provide economic incentives to save it (efficiency objective), to recover direct and indirect costs related to its production (cost recovery objective), taking into account equity considerations and constraints of administrative and political feasibility. In this chapter, we only cover France's territory in Europe (Metropolitan France), but we do not consider French overseas départements[1] and territories.

8.1.1 Climate Diversity

Metropolitan France is the largest country among European Union members, with 543 965 km^2, located in the northern temperate zone. The wide diversity of landscapes, from coastal plains in the north and west to a variety of mountain ranges in the southeast (Alps), center (Massif Central), and south (Pyrenees), results in four different climate areas:

- Oceanic climate (southwest, west, and north), with average rainfall all year long and a reduced range of temperatures
- Continental climate (inland and east), with a wider range of temperature from winter to summer and rainfall in spring and summer
- Mediterranean climate (southeast), with hot and dry summers, episodic but heavy rainfall (violent storms in autumn)
- Mountain climate, with important rainfall and a wide range of temperatures

8.1.2 Abundant but Unequal Distribution of Water Resources

France is endowed with abundant water resources and important natural water storage, due to the numerous mountain areas (south and east) and large littoral zones (west and north).

Yearly average rainfall volume is 486 km^3, of which 175 km^3 turns into effective rainfall. From these available water resources, 75 km^3 flows as surface water, while the remaining 100 km^3 percolates to aquifers. These latter volumes are then released over time to rivers to form the basic stream flow.

[1] The *département* is an administrative division created after the French Revolution. Territorial state services at this level are led by a prefect. There are also elected representatives who form the *Conseil Général*. This institution has gained in importance since decentralization laws of 1982–1983.

Surface water in France corresponds to more than 550,000 km of rivers (mainly small rivers and streams), with the five main rivers (Rhone, Rhine, Loire, Seine, and Garonne) draining most of France's surface water flows.

Still water bodies include more than 34,000 lakes, reservoirs, and ponds. The 9,800 largest ones cover 2,800 km^2 and have a cumulative capacity of 24 km^3, Lake Leman excluded. Groundwater resources are estimated to reach 2,000 km^3, with about 200 main aquifers and more than 6,300 small aquifers.

Despite abundant surface and groundwater resources on a national level, water resource availability is variable. In the southern and eastern regions, the weather is dry, while torrential rain episodes occur during short periods of time. The total volume of rainfall is thus equivalent to the national average. In most of the other climate areas, rainfall is common all year long, but only mountainous areas receive a higher volume of rainfall, compared to the national average.

In the end, due to a combination of climatic and human factors, drought-prone areas are located not under Mediterranean climate so much as in middle-range Garonne, Charente, western France, and Loire; North of France is in the same situation as southeastern England: 600 mm of rain, no large rivers, and high population density.

8.1.3 Main Freshwater Uses in France

In 2007, about 31.6 km^3 of water was abstracted in France, mainly from surface water (82 %). On the total volume of water resources collected in 2007 (Table 8.1), 59 % was used in thermal power plant cooling (classical and nuclear power plants, excluding most hydroelectricity). The water was mainly pumped from rivers and almost completely returned after use.

- Eighteen percent was abstracted by public water supplies (drinking water), mostly for the needs of urban areas. The total volume collected for drinking water remains stable but undergoes a decline in downtown areas.
- Twelve percent was collected for irrigation, mainly from surface water catchments (rivers, ponds) in southwestern and southeastern France, where crops with high water consumption are grown (e.g., corn). The volume of water collected for irrigation slowly increased over previous years on a national level but faster in the south and west.
- Only 10 % was abstracted by industry. Industrial water use is chiefly taken from surface water (59 %) and is mainly located in northern and eastern France, mostly for paper production and metallurgy. Water volume collected for industry use continuously decreased over the past decades (−30 % since the 1970s).

Data for irrigation is usually underestimated due to difficulties in monitoring private wells. The equivalent figures 15 years before were (1) 6.0 for public water supply, (2) 3.9 for industry, (3) power plant cooling peaked at 24.2, and (4) irrigation was around 3.9 for collective schemes and 4.9 including private wells (our estimation in the Eurowater report). It is clear then that the only growing water

Table 8.1 Freshwater resources available in 2007 and their uses

In billion cubic meters and percents										
(Source)	Drinking water		Industry		Irrigation		Energy		Total	
Surface water	2.2	37 %	1.8	59 %	3.1	80 %	18.8	100 %	25.9	82 %
Groundwater	3.6	63 %	1.3	41 %	0.8	20 %	0.0	0 %	5.7	18 %
Sub total	5.8	100 %	3.1	100 %	3.9	100 %	18.8	100 %	31.6	100 %
% by use	18 %		10 %		12 %		59 %		100 %	

Bommelaer and Devaux (2012)

demand is from agriculture, which has an obvious consequence on water scarcity: agricultural water demand is concentrated in 20 % of national territory. Irrigated surfaces doubled between 1980 and 1990 in France and grew particularly in a large southwestern portion of the country. If abstracted volumes remain small compared to power plant cooling needs, water consumed (i.e., not returned to the ecosystem) by agriculture halves the total, and abstractions reach 80 % of the total in the summer. It is then clear that droughts reveal a man-made scarcity, which can be alleviated by water reallocation.

Water consumption depends on local conditions, on uses, and also on prices. Water pricing levels and structures can be explained in France by the French legislative and regulatory framework, which is presented in Sect. 8.2. The following sections will be dedicated to the presentation of the variety of water pricing implemented for the urban use (Sect. 8.3) and the agricultural use (Sect. 8.4) and to take into account environmental constraints (Sect. 8.5). Section 8.6 concludes giving an overview of current debates and future directions of water pricing.

8.2 Historical Overview of French Legislative and Regulatory Framework Concerning Water Prices

Historically, the focus of pricing policy progressively shifted from a budget balance mandate in the 1970s to water conservation (1992 water law) and more recently to a social protection objective (2006 water law and subsequent regulations).

Water prices in France are framed by a national history that seeks, since the creation of the Agences de l'eau (water agencies) in 1964, to price water at its economic value, including environmental cost. It is reinforced by the European legislative framework: the European Water Framework Directive—WFD (European Commission 2000)—published in December 2000 aims at recovering the quality of the aquatic environment and presents economic instruments as ways to reach it. To do so, the European Union (EU) member states have to estimate the full cost of water services (operational, capital, and environmental) and to try to recover it through water pricing. The European Water Framework Directive asks also to design water pricing policies in order to provide adequate incentives for an efficient water use.

8.2.1 Water Agencies on How to Target Full Cost Pricing

In the 1960s, the booming economy, the rapid urbanization process, and the catching up with sewerage infrastructure delays led to increased situations of scarcity and to massive pollution discharge in rivers. Under the Gaullist government, the planning system expanded to encompass more than initial industrial development, typically targeting global regional and urban planning. Concerning water, a special committee on water problems studies was set up to propose solutions, and it came up with the idea of controlling both pollution and scarcity at the river-basin level. They took members of parliament and of the senate to visit other countries, and they finally chose to adopt/adapt the Ruhrverband model: urban and industrial water users would be qualitatively represented in a Comité de bassin (basin committee), which would both decide priority investments on a 5-year planning basis and vote the levies, and each of them would have to pay to fund the resulting budget up to 35 %. Investments proposed by stakeholders would be subsidized at 10 % and granted a zero-interest loan for another 20–40 %. This system started to operate in 1970 and would lead to important water pricing increases. By the way, it can be compared with the United States Clean Water Act's revolving fund, with an important difference though: from the beginning the fund was made up with water users' contributions and not the government's.

In more decentralized countries like Germany and the Netherlands, typically water boards have this taxation power, plus some police powers, and also the possibility to build and operate infrastructure (dams, sewage works) by themselves. These two additional roles were not granted to the six French water agencies, which ended up being almost like mutual savings banks of water users, in which contributions would be mandatory. This system is described by Colin Green (personal communication to B. Barraqué) as "hypothecated levy," you must pay, but you can get your money back if you decide to go environmentally friendly. And as a matter of fact, this system allowed adding 16,000 sewage treatment plants to the 1,000 that existed in 1965. It also allowed to fund a few multipurpose reservoirs, initially for enhancing low summer flows (water supply of large cities and nuclear power plant cooling needed river regulation) and, eventually, also for flood control.

The taxation system was made up of two different levies: one is a (small) water abstraction levy, itself composed of a tiny levy for abstraction and of a larger levy for water consumed (i.e., not returned to the aquatic environment); another levy, about five times larger for urban water uses, was targeted on pollution discharge; the quantification was based on biological oxygen demand (BOD), chemical oxygen demand (COD), suspended particulates, heat, toxic substances, and, later, also phosphates and nitrates.

Why did this financial system impact water tariffs? Indeed, the taxation should have targeted the initial abstractors and the end dischargers (i.e., industrial premises non-connected to public sewers, large farms[2]) and, for cities, the water

[2] Initially farmers were protected and they only paid the abstraction levy when they pumped important amounts of surface water. They did not pay any tax for diffuse pollution discharge. Only later a taxation of battery cattle breeding would be introduced, but quite painfully.

supply and sanitation (WSS) public services, which are under the responsibility of local councils.[3]

However, everybody resisted the new green taxes. Industry, of course, claimed that it would reduce their competitiveness, but thanks to the ongoing national planning system, they obtained the signature of "branch contracts," in which they could pool the taxes they paid to the six water agencies at the national level, and received additional grants from the ministry of industry, while co-deciding with the industrial environment government services the phasing of pollution control works in the branch's premises. This practice was condemned by the European Commission, but by that moment, industry had understood it was in its own interest to play the depollution game.

The opposition from local authorities was more serious: the Association of French Mayors voiced against having to pay a tax to institutions that were not elected one man, one vote (i.e., which were not sovereign as they were). In order to escape the central-local conflict, which was already important, the government decided to charge for levies through the water supply bills. The government passed a decree in October 1967, which considered sewerage a service rendered the same as the water supply. Therefore, sewerage charges would be included in water bills and in proportion of drinking water purchased (metering is generalized in France) and no longer through local land and housing taxes. With that change, it became simpler to include the abstraction and pollution discharge levies in the water bills. This would lead to important price increases, since the long-term cost of sewage collection and treatment, without subsidies, was above water supply costs. Since the local water supply authorities and not the water customers received the financial support of the water agencies, the tariff system was criticized by some consumers and alter-globalist NGOs as being opaque and unfair to domestic users. It certainly still constitutes part of a water tariff crisis today.

However, if we recall that the pollution discharge levy is far higher than the abstraction levy, it can be readily understood that investments needed to improve the environmental performance of sewage collection and treatment has always been more important than those needed to improve drinking water reliability. Since money paid to water agencies acting as a savings bank will, over time, be returned to water users to support needed investments, adding the pollution levy to the wastewater portion of the bill represents the long-term (partly mutualized) average cost of sewage collection and treatment. Symmetrically, the sum of the abstraction levy and the drinking water portion of the bill will represent the long-term average cost of water supply (Fig. 8.1). Even though the wastewater charge paid to the local operator is only two-thirds of the water supply bill, once the long-term costs are considered, wastewater is above drinking water, just like in other countries where there is no such mutual funding system of the water agencies.

But there is another interpretation to be made of the two levies, in terms of full cost recovery: the pollution discharge levy can be considered as representing the environmental cost above the full internal cost (in France, it is mandatory for WSS

[3] Since the initial water agencies were lightweight institutions, in the beginning they did not target villages below 500 inhabitants, which additionally had no sewer systems.

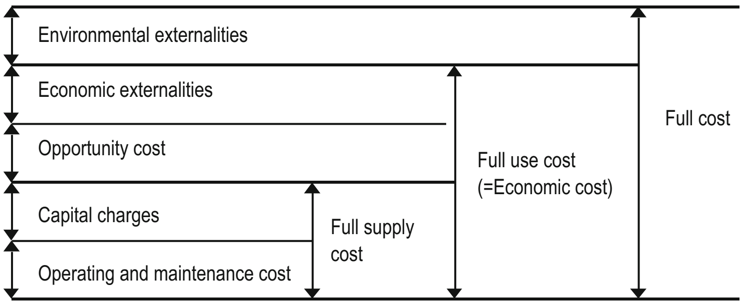

Fig. 8.1 The notion of full cost pricing (Agarwal et al. 2000)

services to cover operation costs, plus a reasonable figure for depreciation, i.e., full internal cost). And since the abstraction levy is there to fund investments to reduce situations of scarcity, one can consider it as the last part of full cost (i.e., users' costs). The only thing is that these two additions to reach full cost recovery are (a) mutualized and (b) not necessarily representing the real economic calculations of environmental and users' costs but rather a proxy obtained after the arbitration on the budget by the Comité de bassin (basin committee).

In the end, it implements the ideas of the "inventors" of the water agencies, which decided that France needed to introduce economic incentives both to reduce pollution and to reduce rivalries in quantity, as expressed in a book by Ivan Chéret, secretary of the committee on water problem studies, way back in 1967 (Chéret 1967).

8.2.2 A French Regulation as a Mix of European Legislative Framework and National Fluctuant Objectives

French water laws address only the case of urban water pricing, while other uses are being regulated by other instruments, such as quotas and levies at the river-basin level or at local levels. For instance, the 2006 French water law (Loi n°2006–1772 sur l'eau et les milieux aquatiques 2006) does not regulate raw water pricing (water used directly by farmers or industries) and prefers quantitative instruments to share water in scarcity areas, apart from the incentive put through water agency levies. It is at the local level, for instance, at the river-basin catchment, that we find regulation imposing to enhance incentive water pricing structures: an example is given by the SDAGE[4] Adour-Garonne (southwest part of France), implemented in 2010, which obliged water managers to generalize incentive pricing and then encouraged water conservation to guarantee water sustainability, particularly during low-flow seasons (Comité de bassin Adour-Garonne 2009).

[4] French acronym for master plan at hydrographic district level: *Schéma Directeur d'Aménagement et de Gestion des Eaux.*

For the case of urban water pricing, the first law addressing this aspect was voted in November 1992. It required all WSS services to balance their budget (except tiny villages), and not just the municipal global budget, by January 1993 (Montginoul 1997), as it was allowed previously for direct procurement.

The second law addressing water pricing is the 2006 French water law, which translated the 2000 European Water Directive to conditions in France. Its Article 57 is devoted to potable water and sewerage pricing and clearly aims at encouraging water conservation. In particular, Article 57 forbids (except for small cities and cases with plenty of water) flat rates and declining water rate structures. Forbidding declining block rates impacts large housing projects but also industry (i.e., large consumers who were granted this type of discount by many utilities).

Article 57 also limits the fixed part: it cannot represent more than 30 % (for urban districts) or 40 % (for rural services) of water bill (calculated for 120 m^3 annual consumption), except for utilities facing a high seasonal population. It is in fact more restrictive because this obligation is put separately on the two parts of water bills—potable and sewerage—not including taxes and fees.

8.3 Water Pricing Practices in Urban Sector (Including Industry)

The urban sector represents all users connected to the public potable water network, including households, hotels and commerce, public services, and industry. Urban water pricing is increasingly regulated in France: the 2006 law has induced drastic changes for some WSS units, in which water pricing structures did not fit the new rules.

The evolution of tariff structures is analyzed in this section using results from two national surveys conducted in 2003 and 2013 (Montginoul 2007). These surveys were carried out on the same 1,630 French districts selected following a stratified sampling procedure (taking into account three types of factors: geography, population size, and level of seasonal population). It was structured to collect information on the characteristics of water and wastewater management utilities, the detailed water bill, and the eventual existence of pricing specificities. The response rate was 29 % in 2003 and 40 % in 2013, with 429 (respectively, 393) answers totally exploitable. The results were adjusted to be fully representative of the French situation.

The average price (including VAT) in France in 2013 is 3.73 €/m^3 (Table 8.2). However, there is considerable variation in prices across municipalities, because water is priced at a local level, taking into account local conditions, and the fact that 25 % of water service units (small size, however) do not have collective sewerage and let households face the costs of decentralized solutions (not in bills).

On average, the fixed part is 44 euros for potable water (equivalent to a consumption of 29 m^3) and 23 euros for sewage collection and treatment (16 m^3 consumed). This low

Table 8.2 Average French water prices in 2003 and 2013

(2013 constant prices)	2003	2013
Water		
Proportional part	1.59 €/m^3	1.61 €/m^3
Fixed part	37 €/m^3	44 €/m^3
Fixed part in equivalent water consumed	29 m^3	29 m^3
Average price (for 120 m^3)	1.91 €/m^3	1.97 €/m^3
Sewerage		
Proportional part	1.11 €/m^3	1.63 €/m^3
Fixed part	13 €/m^3	23 €/m^3
Fixed part in equivalent water consumed	14 m^3	16 m^3
Average price (for 120 m^3)	1.21 €/m^3	1.82 €/m^3
Total		
Proportional part	2.69 €/m^3	3.18 €/m^3
Fixed part	51 €/m^3	65 €/m^3
Fixed part in equivalent water consumed	23 m^3	22 m^3
Average price (for 120 m^3)	3.11 €/m^3	3.73 €/m^3

Montginoul (2007) and 2013 survey
2013 constant prices – *1 € 2013 = 1.3288 US$*

level is mainly explained by the fact that sewerage is chiefly priced with a volumetric rate, while the cost of metering and billing is usually attached to potable water.

In most cases (for 96 % of French utilities corresponding to 95 % of the French population), water is charged with a two-part structure. The simple volumetric rate is only found in 3 % of utilities (representing 5 % of the population). The flat-rate structure remains anecdotal, concerning only 1 % of French supply units (rural), which hardly represents a few per thousand of the population.

The proportional water part charged to users is constant in 61 % of the utilities, corresponding to more than 72 % of the population (Table 8.3). Thirty-six percent of the utilities used a declining block tariff structure in 2003 vs. only 4 % in 2013 following the new regulation. On the contrary, the proportion of utilities with increasing block structure has drastically increased, representing only 1 % (5 % of the population) in 2003 and 29 % (11 % of population) in 2013. An additional 4 % of French utilities have a more complex price structure, combining increasing and declining block rates.

We have described above the total bill (corresponding to both drinking water and sewerage services). This bill is highly influenced by the amount of drinking water consumed (Table 8.4). The sewerage part, for the 75 % of utilities that have a sewer system, is priced in a different way. This difference is particularly high in terms of population: when it exists, sewerage is priced with a volumetric rate for 51 % of French inhabitants (even if this weight has decreased since 2003).

Table 8.3 Distribution of the types of the volumetric part (for water and sewerage services)

	2003		2013	
	% of districts	% of population	% of districts	% of population
Simple	57 %	71 %	61 %	72 %
Declining	36 %	20 %	4 %	8 %
Complex	3 %	4 %	4 %	9 %
Increasing	1 %	5 %	29 %	11 %
Flat rate	3 %	–	1 %	0 %

Montginoul (2007) and 2013 survey

Table 8.4 Distribution of rate structure for drinking water and sewerage separately

		2003		2013	
		% of districts	% of population	% of districts	% of population
Drinking water	Volumetric rate	4	6	3	5
	Two-part rate	93	93	95	95
	Flat rate	3	–	2	–
Sewerage	Volumetric rate	22	63	21	51
	Two-part rate	34	27	52	44
	Flat rate	6	2	2	1
	No central sewer	39	8	25	4

Montginoul (2007) and 2013 survey

Moreover, the constant rate structure dominates for sewerage (61 % of districts, 72 % of inhabitants), and a block-rate structure is not common but rising and changing from a decreasing block-rate structure to an increasing one.

In addition to this structure, some specificities can be highlighted: 3 % of utilities (9 % of population) have implemented a "social access to water" principle. This is done through the definition of social water pricing or through subsidies directly given to poor households. Seven percent of utilities applied industrial water pricing in 2013 (one-third in 2003), mainly through a decreasing block rate. However, in order to follow the last French water law, a new water pricing structure has emerged: the optional one. This structure can be analyzed as a way to continue to propose a decreasing block price through the back door. Finally, the last 10 years has been the arena of multiple tests and implementation of innovative water pricing structures: optional water pricing and seasonal water pricing (sometimes combined with increasing block rates).

8.4 Water Pricing Practices in the Agricultural Sector

Irrigation water charges depend on water management types. We can distinguish roughly three types (Montginoul 1997): a farmer who individually extracts water without any intermediary, a farmers' association (small-scale water user association called ASA—Association Syndicale Autorisée) that extracts and distributes water to its members, and a regional development company (named SAR—Société d'Aménagement Régionale) that delivers water to farmers (or to farmers' associations) through a large collective network or a resupplied river.

8.4.1 Individual Extraction of Water Resource: Only Water Agency Fee

In that case, there is no water pricing, because there is no water service delivery. Investment and operation costs of the system are both fully supported by farmers. Irrigators can however be incited not to waste water through the water agency abstraction levy, the energy pumping cost, and the new water license due to a collective water management institution, called Organisme Unique de Gestion Collective (OUGC), when it exists in water scarcity river basins.

8.4.2 Farmers' Associations: A Water Price Built to Cover Financial Costs

Farmers' associations (mostly organized into a legal association format—ASA) deliver water through a collective network. They fix water prices to cover expenses (only rarely water pricing will also aim at managing water). The price is set to maintain the water delivery network, to cover exploitation costs and the part of investment costs not paid by subsidies (which usually represent 60–80 % of the capital cost).

Water pricing structures are highly diverse, reflecting a variety of situations. We illustrate this fact through the presentation of two former surveys, the main conclusions of which remain valid.

The first survey (Gleyses 1998) covers the situation in southern France (i.e., Adour-Garonne and Rhône-Méditerranée and Corse river basins). Seventeen water pricing structures were identified, with three main ones: all gravity-fed systems are billed with a flat-rate structure for 70 % of them, based on the subscribed surface; water pricing structures in pressure irrigation networks are more varied—81 % of them have binomial water pricing; the remaining 19 % apply a flat-rate structure based on subscribed discharge or surface or on a combination of subscribed and irrigated surfaces. For binomial pricing, the fixed part is priced for 41 % of cases on the subscribed surface and for 20 % on the subscribed discharge.

The second survey (Gleyses 2004) was done in northwestern France (Loire Bretagne river basin). In that region, traditional associations (ASA) represent only 23 % of collective irrigation structures, but 60 % of farmers are connected to a collective irrigation network. This region is also characterized by the absence of collective gravity networks. This survey confirms the predominance of binomial water pricing, widely implemented in pressure water networks, based on subscribed surface or discharge. It identifies three cases in which water is charged through a flat-rate

Table 8.5 Water pricing structures in 2003 in Loire Bretagne river basin

Water pricing structure	Proportion of water pricing structure			Average price	Average water pricing	
	Networks (%)	Farmers (%)	Volume (%)		Fixed part	Variable part
Flat rates						
Subscribed surface	19	17	23		198 €/ha	
Other 5 flat tariffs	5	2	5			
Total 6 flat tariffs	***24***	***19***	***28***	***0.09 €/m³***		
Binomial						
Subscribed surface	36	32	33		81 €/ha	0.06 €/m³
Subscribed discharge	4	13	8		38 €/m³/h	0.06 €/m³
Other 12 binomial tariffs	10	30	19			
Total 14 binomial tariffs	***50***	***75***	***60***			
Volumetric						
Strictly proportional	20	5	11			0.10 €/m³
Three other modalities	5	1	1			
Total 4 volumetric tariffs	*25*	*6*	*12*			
Total of 18 tariffs with a volumetric part	***75***	***81***	***72***	***0.12 €/m³***		
Total of 24 tariffs	**100**	**100**	**100**	**0.11 €/m³**		

Gleyses (2004)
1 € 2003 = 1.0622 US$

system, ten binomial water pricing systems, and four volumetric pricing structures, mainly implemented in very small irrigation systems that have not adopted the ASA legal structure. Table 8.5 describes levels of prices, water pricing structures implemented, and their weights in terms of number of networks (farmers' association), number of farmers, and of river-basin water volume.

The diversity of water pricing across farmers' association networks illustrates the autonomy of these associations in terms of water pricing. However, this heterogeneity does not always reflect service costs' heterogeneity: there is no statistical difference in terms of price level between the two main binomial water pricing structures (Table 8.6).

The tariff structure reflects in particular the age of the irrigation network (Fig. 8.2): flat rates are preferred in young networks, which have to repay loans. The proportional part increases with the age of the network. At the beginning, expenses are mainly fixed (annual loan charges can represent more than half of the total budget), and a flat-rate structure guarantees to cover charges even for a wet year. Moreover, implementing a binomial rate structure increases management costs

Table 8.6 Irrigation cost for four types of water pricing

River basin	Base of fixed part for binomial tariff	Average tariff (in € 2004)		Average cost for 2000 m^3/ha/year
		Fixed part	Proportional part	
Adour-Garonne and RM&C (Gleyses 1998)	Subscribed surface	107 €/ha	0.062 €/m^3	232 €/ha
	Subscribed discharge	45 €/m^3/h	0.056 €/m^3	208 €/ha
Loire Bretagne (Gleyses 2004)	Subscribed surface	81 €/ha	0.060 €/m^3	201 €/ha
	Subscribed discharge	38 €/m^3/h	0.060 €/m^3	202 €/ha

Adapted from Gleyses (2004)
RM&C Rhône-Méditerranée and Corse. 1 € 2000 = 1.0137 US$, 1 € 2004 = 1.2613 US$

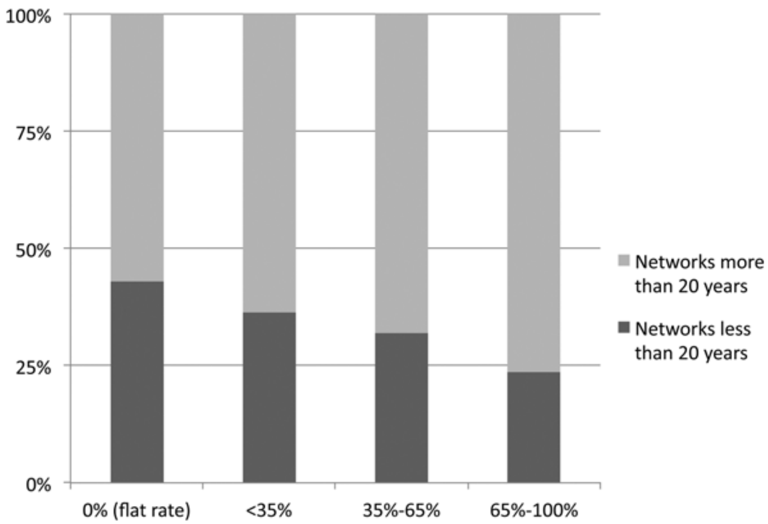

Fig. 8.2 Weight of the proportional part in farmers' association water price depending on the age of network in Loire Bretagne river basin (Gleyses 2006)

(reading water meters, preparing water bills, among other tasks) and water charges due to the obligation to buy water meters during a period in which water charges are already high due to the new investment.

Water tariff structure changes when there are no more loans to repay and when proportional expenses represent a large part of total expenses. Progressively, farmers' associations shift for binomial pricing. In parallel, average price levels decrease, following the decrease of expenses. This situation can also be explained for equity reasons, when some farmers who do not consume much water refuse to pay for the others (Garin and Loubier 2007). Another consequence of the shift from a flat-rate structure to a binomial one is the reduction of volume consumed (mainly wasted volumes) and then of the irrigation cost (Loubier and Garin 2008).

8.4.3 Regional Development Companies: Cost Recovery and Water Conservation

Regional development companies (SAR) are large public irrigation schemes, located in southern France. They were initially created in the 1960s to help economic development of the three regions (Adour-Garonne for the Compagnie d'Aménagement des Côteaux de Gascogne, CACG; Languedoc Roussillon for Bas-Rhône-Languedoc, BRL; and Provence-Alpes-Côte d'Azur for Société du Canal de Provence, SCP). Their pricing structures were mainly designed to incite farmers to irrigate but also to cover costs. Water conservation is often a secondary objective pursued through water pricing (other instruments like quotas were favored) or was only imposed in recent years by local regulations. Water pricing structure and underlying philosophy have been very stable since their creation in the 1960s. Only few adjustments were made. Two main pricing systems have to be differentiated.

8.4.3.1 Water Pricing in Resupplied River, Based on Cost Recovery

CACG manages a complex system called "système Neste" composed of dams, resupplied rivers, and a canal implemented in 1863. Users have to pump water in resupplied rivers and to pay for the service. In 2013, the average cost paid by users is 0.03 €/m^3, which represents 78 € per liter per second subscribed.

Because of a high water demand and the network through which water is distributed (rivers), CACG chose, since the beginning of its concession in 1991, to share water through a discharge quota: the user paid according to the 4,000 cubic meters per liter per second subscribed. If user exceeded the quota, he had to pay a considered-deterrent price, corresponding to eight times the average price level. This type of water pricing structure does not incite farmers to save water.

In order to respect the new local regulation (Comité de bassin Adour-Garonne 2009), CACG decided to introduce a volumetric portion of the water bill. This is however restricted following the assumption that irrigation is an "all-or-nothing" decision and the farmer has only the option to "take" or not take the last water turn and then can save at most 20 % of the allocated quota. Pricing consists therefore in a binomial structure with three increasing block rates: a fixed rate, representing 80 % of the previous bill associated with a first null volumetric part ($p_0 = 0$) for the associated volume; a volumetric rate (p_1) calculated to cover the remaining 20 %; and $p_2 = 8 * p_1$ to dissuade farmers from consuming more than the allocated quota.

8.4.3.2 Water Pricing in Collective Pressure Networks, Based on Equalization, Cost Recovery, and Incentive Principles

In their initial concession perimeter, SAR implemented water pricing that was based on the three principles of equalization, cost recovery, and incentives to save water. Each SAR has a specific manner to respect these three principles.

For SCP, equalization is designed at a use level: other uses (urban, industrial, etc.) compensate discount (corresponding to originally 40 % of the real cost and currently to 60 %) made for irrigation uses. For CACG and BRL, equalization is done at a territory level: CACG has defined three perimeters, including relatively identical farming practices in terms of income; water price level is higher in the perimeter corresponding to wealthy farmers and smaller in the one that regroups the poorest. BRL applies the same price to all farmers located in the same department, whatever the supported cost, which increases with the distance to the main canal. The underlying assumption is that it favors farmers located far from the canal, who are the poorest. In order to maximize water user surplus and also to improve the knowledge of the type of water utilization,[5] BRL has adopted an optional water tariff (Fig. 8.3). Finally, BRL applies reduced prices for young farmers or water bill discounts for farmers facing high water bills during dry years.

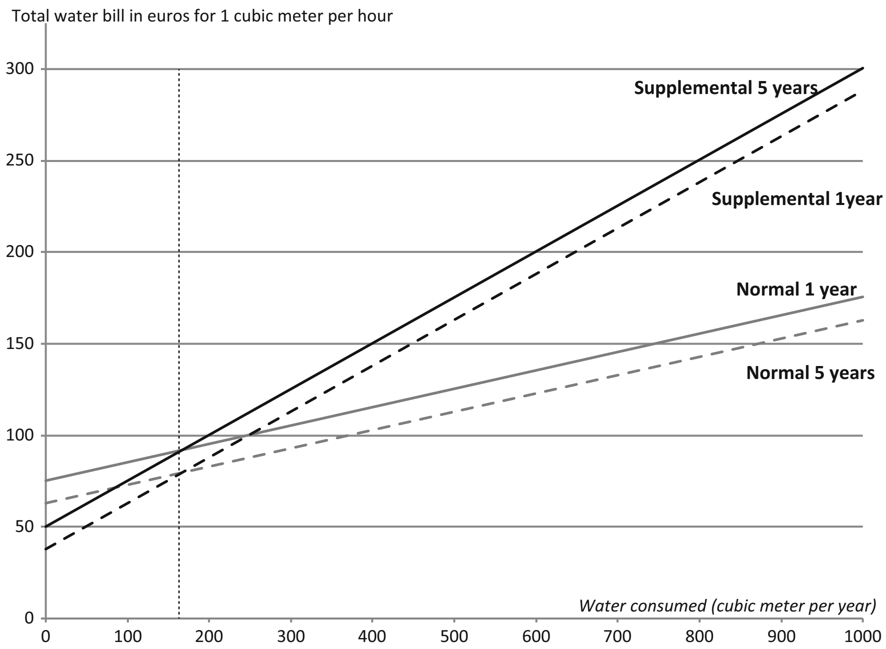

Fig. 8.3 Total water bill according to tariffs (subscribed flow: 1 cubic meter per hour) (Source: compiled by M. Montginoul from BRL 2013 water tariff. 1 € 2013 = 1.3288 US$)

[5] Farmers choose their contract (normal versus supplemental—five years versus one year) according to field characteristics, cropping pattern, and irrigation equipment.

Cost recovery is calculated for BRL and CACG, taking into account average cost, whereas SCP bases its water price on long-term development cost, pursuing the Boiteux pricing principles (Boiteux 1971). To follow the marginal pricing principle, SCP applies a tariff higher when users are far from the source or when it is needed to pressure water and in the peak season. SCP aims also to incite users to subscribe discharges at the needed level and not in excess. That is why, for irrigators, a flat rate is partially applied, corresponding to a consumption of 100 cubic meters per liter, per second subscribed.

The last principle that guides water pricing is linked to the incentive to save water, except, sometimes initially, when first developing an irrigation system. Water pricing structures are binomial everywhere, even if sometimes with a flat but limited rate. SCP applies seasonal water pricing: water tariffs during the summer season are higher than those applied in the winter season. Besides saving water, the underlying objective is to incite users to store water during the winter for use during the summer period to reduce peak demand and smooth water demand.

In the SAR perimeter, the water pricing structure takes a binomial form, with a fixed part priced per liter, per second subscribed. For instance, CACG prices water in its concession perimeter on average at 360 € per l/s + 0.065 €/m^3 (corresponding to the energy cost). Table 8.7 presents average prices for SCP and Table 8.8 tariff grid implemented by BRL. In this last case, BRL designed its tariff to benefit

Table 8.7 Average water prices in 2012 (€/m^3) in the SCP concession perimeter, detailed by subsectors

	Irrigation by farmers	Watering	Domestic raw water	Other uses	Water for industries	Urban (raw water)	Urban (potable water)
Area 3 SCP	0.11	0.49	2.10	0.58	0.60	0.28	–
Area 2 SCP	0.20	0.49	2.51	0.63	0.31	0.39	0.83
Area 1 SCP	0.21	0.58	2.34	0.72	0.47	0.56	0.58
Valensole	0.28	1.13	2.06	1.13	–	–	0.77
Montmeyran	0.20	0.48	–	–	–	–	–
Rieu Vancon Buech Durance	0.25	0.87	–	–	–	–	–
Manosque	0.18	0.80	–	–	–	–	–
Total	**0.19**	**0.54**	**2.46**	**0.66**	**0.43**	**0.48**	**0.61**

1 € 2012 = 1.2905 US$

Table 8.8 Main tariffs implemented by BRL in 2013 before taxes and environmental fees

Type of contract	Type of tariff	Subscription fee (per cubic meter subscribed)	Proportional fee (per cubic meter consumed)
Long term (5 years)	Normal	62.656	0.1003
	Supplemental	37.593	0.2505
Short term (1 year)	Normal	75.188	0.1003
	Supplemental	50.125	0.2505

1 € 2013 = 1.3288 US$

long-term contracts rather than short-term contracts. A supplemental irrigation contract is characterized by a cheaper subscription fee but a higher volume fee, which benefits supplemental needs, for example, a vineyard that does not need to be irrigated each year.

No fundamental changes have been made these last decades, except some adjustments to follow previously described principles. For instance, the index formula, which bases the adjustment of water price levels, is revised in the different SAR to take into account the evolution of weights of the different cost components. SCP is currently adjusting its pricing zones to homogenize the water price in similar and closed areas, which was not the case in the past due to the fact that different entities were in charge of water distribution. CACG engaged a reflection on the equalization principle as it was put in place in its concession perimeter, proposing to implement a uniform price or, on the contrary, to adapt prices to local costs. Farmers refused, arguing the equalization principle, and then preferred to maintain the in-place water price with three price areas.

8.5 Taking into Account Environmental Services: Water Agency Fees

As described in the historical part, water agencies levy taxes to follow the polluter/user-pays principle. Currently, there are ten taxes addressing the different water services (Table 8.9).

These taxes have increased in level and now represent a non-negligible part of water prices. Looking at the historical trend of urban water pricing, one can see that the water agency weight has increased, especially for the pollution levy after the adoption of the European Urban Waste Water Directive (EC 1991/271) (European Commission 1991). Indeed, since 1996, the addition of a pollution discharge levy with a wastewater fee is higher than the addition of the abstraction levy with a potable water price (Fig. 8.4).

In river basins where water demand largely exceeds water supply, the 2006 water law allows a modulation of the withdrawal tax. It can be divided by two, if a unique collective agricultural water management institution (generally managed by agricultural organizations) is implemented. These institutions are in charge of reallocating among farmers the global state allocation to the agricultural sector. The functioning cost of these institutions is partly supported by water agencies during the first years and progressively transferred to farmers through a service fee. This service pricing can be as variable as those of collective irrigation systems. However, it offers one more possibility, mostly chosen, that consists of pricing according to volume farmers choose to use. This system incites farmers to curb their water demands.

Table 8.9 Water agency taxes. Levels in 2013 in the Rhône-Méditerranée and Corse (RM&C) river basin

Water agency taxes	Uses	Calculation	RM&C level in 2013
Domestic pollution	Urban uses	Proportional to urban water consumption	0.23 €/m^3
Nondomestic pollution	Industrial or economic uses	Proportional to generated pollution	Rates depending on type of pollutants
Sewer systems' modernization	Users connected to a sewage public network	Proportional to volume discharged in sewer network	0.15 €/m^3
Water withdrawal	All users	Proportional to withdrawn water	Depends on the use, the level of water scarcity, and the collective or noncollective management
Hydroelectric production	Hydroelectric uses (>1 billion cubic meter per year diverted)	Proportional to diverted water	1.2 € per billion cubic meter and per meter of waterfall height
Non-point source pollution	Phyto-pharmaceutical uses	Proportional to toxicity	5.1 €/k when dangerous for wealth. 2 € when only dangerous for environment
Livestock pollution	Livestock (>90 livestock units)	Proportional to livestock unit	3 € per livestock unit from the 41e one
Barriers on rivers	Owners who modify natural river systems except hydroelectric uses	Proportional to meters' length of the barrier	150 € per meter
Water storage	Entities who store water	Proportional to water stored in peak period	0.01 €/m^3 stored
Aquatic protection	Recreational fishermen	Per recreational fisherman	8.8 € for 1 year and one adult + 20 € for specific species

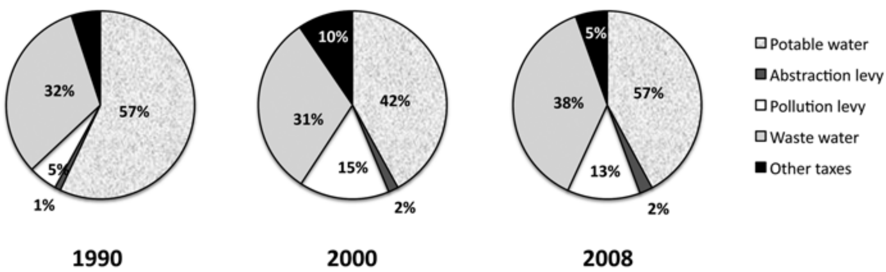

Fig. 8.4 Evolution of average urban water price and breakdown in France (Source: compiled by B. Barraqué from national environment statistics. Constant 2008 euros. 1 € 2008 = 1.4570 US$)

8.6 Conclusion: Current Debates and Future Directions

Water pricing is still currently subject to debate. However, it can be noted that conflicting signals between French policies have been reduced, increasing the weight of water price in consumption behavior. For instance, French agricultural policy diminishes incentives to irrigate: before the last European common agricultural policy reform, farmers received a subvention from 0.1 to 0.15 euro per cubic meter, a sum similar to or even higher than water price. Since 2013, France's irrigated area has been reduced, and we observe an intensification of irrigation. Indeed, direct subvention currently accounts for only 25 % of the previous one.

Water price is designed taking into account various (and sometimes conflicting) objectives, which have to be addressed directly or indirectly through other instruments (for instance, quotas). The three main objectives are balancing water budget, allowing water access (to poor households but also to maintain farmers, especially the smallest), and inciting users to save water. These objectives are more and more difficult to achieve, due to the current trends: a tightening of environmental constraints (European Water Framework Directive asks European states to achieve in 2015 good status of water bodies); a climate change, which enhances water demand; an economic crisis; and a sharp increase in energy prices, which impacts all incomes (households, farmers, industries).

In that way, for the next water agencies program, the SDAGE plans to condition aids to both climate change impacts and mitigation of the project, requiring subsidies and collective economic benefits of the project territory. In the SDAGE as well as in the WFD, special attention will be paid to water pricing (basic measure for reaching good ecological status) and cost recovery.

Water agencies will also recommend developing contrasted scenarios for the most important driving forces and uncertainties to insure their effectiveness regarding climate change and economic return.

Enhancing water agencies' fees does not seem a good solution to incite users to save water, because of the sharp increase it would require causing opposition by the users. For instance, for irrigation use, it would consist of an increase up to 20 times the actual water agency fee's level to provide a real incentive.

That is why France preferred quantitative instruments to share water between users, defining in each water-scarce area the maximum annual abstracted volume. For urban water uses, a combination of incentive instruments (see Article 57 of 2006 water law[6]) and water efficiency measures is preferred, and quotas remain the most efficient way to share water between farmers. However, costs incurred by the organization responsible to share water between farmers (OUGC) should take into

[6] Abstracts from Rule 57—Article L. 2224-12-4: I. Each water bill includes a sum depending on the consumed volume and can also include a fixed part taking into account water management fixed costs and the characteristics of the connection pipe (in particular the number of served flats. This fixed part cannot exceed a ceiling defined by a Ministerial Order. […] In case of abundant resource water and of restricted connected users, a flat rate structure can be implemented. […] III. From January 1, 2010, declining rates are forbidden, except in case of abundant resource water. IV. Seasonal water tariffs can be defined in districts facing seasonal water scarcity. […].

account different billing bases, such as the requested volume (the real consumed volume is legally excluded as a billing base). This base may, however, have an incentive impact on water consumption: the requested volume defines the maximum volume that a farmer can withdraw. It is an ex ante incentive, whatever the real climate and every other factor influencing the irrigation season water consumption.

The question of social access to water has especially increased in France these last few years due to the economic crisis. To address this question, in March 2014, a new law (Loi Brottes) allows testing social water and sanitation tariffs. The underlined philosophy is to experiment tariffs, taking into account households' size, type, and/or income. Helping poor households to pay their water bill either ex ante or ex post (i.e., outside water price) is also allowed.

Current debates on water pricing are also in some ways linked with collective water distribution networks' sustainability. The first one concerns urban management and especially in rural areas. The legal limitation of the fixed part weight in the water bill may raise concerns for the water budget balance and then the sustainability of the delivery system, especially in rural areas facing a high seasonal population but not considered as touristic ones. This legal limitation also poses problems for sewage cost recovery, when secondary water inflows represent an important share of water to be treated. This is the case in particular when there are undeclared individual water supplies through tube wells, for instance.

The second one concerns industries. As soon as water agencies started to levy pollution discharge fees on industrial premises, companies started to change industrial processes to conserve water, and indeed water abstraction dropped from above 5 to around 3.5 km^3/year. But, as previously pointed out, districts with industries were used to price water with a decreasing block-rate structure. With the new water law and the ban of decreasing structure, industries are tempted to exit from the urban water network. Because they represent often a high part of district water consumption, it may question the sustainability of urban managers.

The third one refers to irrigation management and subsidies often given to finance infrastructures and their renewal. It is tempting to think that reducing subsidies dedicated to upgrade infrastructures will increase the "user-pays" principle and also expect users to reduce water consumption due to the induced water price increase. However, especially in the case of ASA farmers' associations, rights and obligations to pay water charges are attached to land. Therefore, a decrease in investment subsidies will augment loans and the fixed part of water pricing. In that case, the only impact is to reduce farmer income or to incite farmers to increase water consumption for irrigated crops to compensate for income decline resulting from the fixed part increase of the water bill. To sum up, once the irrigated system is created, this measure is inefficient or counterproductive (for instance, reducing maintenance expenses in a non-sustainable way). The only case in which it has a positive impact is at the time of an investment decision: reducing subsidies may give a signal of the nonnecessity to create new irrigation systems and then avoid intensifying pressures on water resources.

To go further, in many cases, collective networks have substitutes mobilized often individually. An increase in water prices induces users (households, farmers, industries, etc.) to decrease their consumption. But some unintended effects happen:

water prices rise, initially intended to generate environmental benefits through reduced water use, and may produce economic incentives for users to drill their own boreholes to satisfy their water needs (Montginoul and Rinaudo 2011). Once the investment has been made, the water cost is then really low, which discourages users to save water. Moreover, individual withdrawals are more difficult to control than collective ones, endangering water resource sustainability.

The challenge in France would be to implement water pricing structures that incite users to save water resources while reaching cost recovery and, last but not least, guaranteeing an access to water for all (households and farmers).

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