EPI WATER

Evaluating Economic Policy Instruments for Sustainable Water Management in Europe

WP3 EX-POST Case studies Comparative Analysis Report

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Preamble

Little empirical evidence is available about the actual performance of economic policy instruments (EPIs) in water resource management, collected in a systematic way across a number of different policy issues. The assessment exercise synthesised in this document is one of a few attempts to fill the knowledge gap. Based on an ex-post review assessment of some thirty EPIs in Europe and elsewhere, described in depth in the deliverable 3.1 (Lago et al, 2011), this report provides the results of the first screening for insights gained and lessons learned. It is a hard task to synthesise a more than thousand pages-long report. This synthesis does not claim to be exhaustive. Initially, it as been produced for, and the final version draws on, the first EPI-WATER review conference which took place in Berlin, January 26-27th.

There are different legitimate ways how to analyse EPIs. The EPI-WATER's WP3 scrutinised single economic instruments and tried to analyse their performance and the drivers behind independently. The collected knowledge will inform the ex-ante assessment of an innovative pool of policy instruments designed to tackle four different policy issues: water scarcity and droughts; excess water and floods; preservation/restoration of good environmental health and ecosystem services; and improving quality of water bodies. This is an ultimate challenge of the EPI-WATER project: based on the past evidence and judgements, to demonstrate the role of EPIs for meeting environmental policy goals, boosting innovation and unfolding competition between different water uses.

The final synthesis drawing on the lessons learned from WP3 and WP4 exercises will be produced in September 2013. Before then, the second EPI-WATER review conference will take place in Spain, January 2013.

Jaroslav Mysiak, project's coordinator

Biobliography

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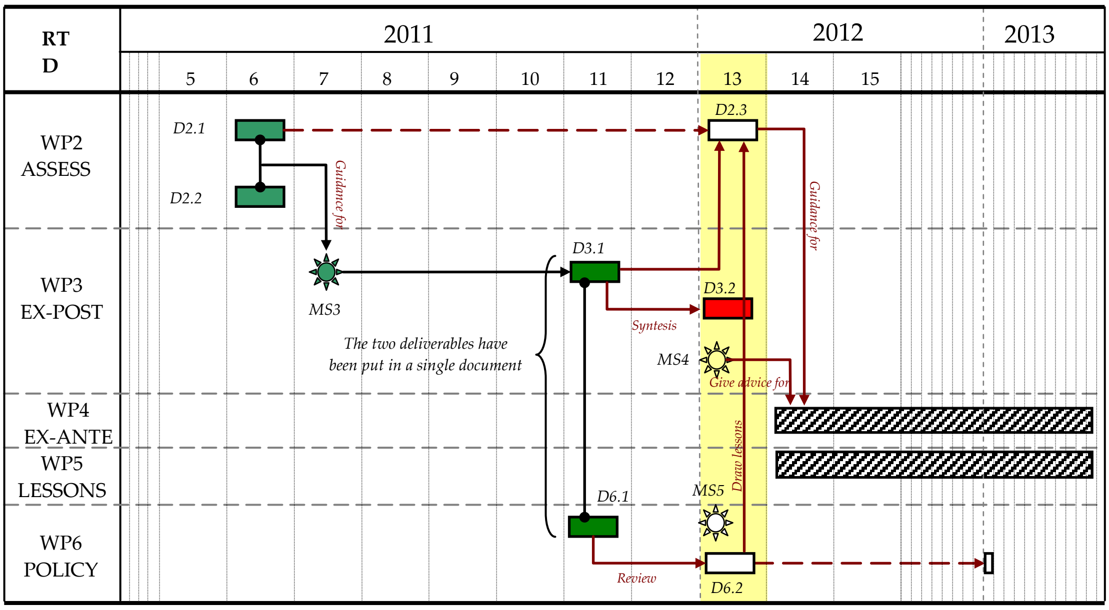
Figure 1. Road map of EPI-WATER *project (this deliverable is highlighted in red)*



Executive Summary

The EPI-Water project applies an evidence-based approach to the assessment of Economic Policy Instruments (EPIs) for water management. In this report, the 30 ex-post case study reviews from the *EPI-Water Deliverable 3.1 Review Studies*[1] are synthesized and cross-compared to extract a *first set* of common features from and formulate hypotheses about the conditions under which EPIs contribute to sustainable water management.

This synthesis report draws conclusions built on the *ex-post* assessment of case studies from Cyprus, Denmark, France, Germany, Hungary, Italy, the Netherlands, Spain, Switzerland, and the United Kingdom, as well as from Australia, Chile, China, Israel, and the USA. A wide range of types of EPIs has also been covered: water-pricing schemes (tariffs, environmental taxes, environmental charges or fees, subsidies on products and practices), trading schemes (tradable permits for abstraction and pollution), cooperation mechanisms and liability instruments.

The synthesis also benefits from the fertile discussions held between EPI-Water consortium partners and other attendees to the First FP7 EPI-Water Conference ('*Understanding the application of economic policy instruments – EPIs – in Water Management: Review of Empirical Evidence, Experiences and Lessons Learned from Europe and Elsewhere*'), that was held in Berlin (January 26th-27th, 2012). Participants to this event included members from academia, consultancy, NGOs, water managers, international organisations, EU institutions and government representatives.

This report does not have the objective to set out the basis for decision makers to choose a particular form of EPI in specific circumstances, nor does it aim to make bold statements about the conditions required for broad categories or individual types of EPIs to be adequate and successful. The aim of the exercise is to lay down a benchmark for other deliverables of the project, which will build upon the assessment developed within WP3 (*ex-post*) and WP4 (*ex-ante*). In the process, some key messages to assist the development of current water policy streams have been identified.

EPIs and water policy goals

The assessment of some the EPIs analysed leads to uneven results and a sense of failure of some of the instruments. This can be due to different reasons:

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[1] In this exercise the performance of 30 EPIs was individually analysed and assessed against an assessment framework containing a set of environmental, economic, social, institutional, and political criteria. The full case studies undertaken to fulfill the reporting requirements of Deliverable 3.1 of WP3 and the report containing only their executive summaries can be accessed in the public area of the EPI-water project web site at: http://www.feem-project.net/epiwater/docs/epi-water_DL_3-1+DL6-1.zip

- EPIs in Europe (and beyond Europe) are quite often not designed with a clear statement of what they are meant to achieve. In other occasions, the aim is explicitly stated (i.e. raising revenue, fostering economic activities, etc.) but without a reference to intended environmental outcomes.
- Many of the EPIs had not been designed with the scope of contemporary water policy, promoted in Europe by the Water Framework Directive (Directive 2000/60/EC), which clearly emphasises on environmental objectives: preserving or restoring good ecological status of water bodies.
- Water management is about (water use) conflict management. EPIs often show a clear trade-off between the preservation or restoration of the good ecological status of water bodies, the contribution to other socially legitimate and valuable uses of water (developmental objectives), and the guarantee of financial feasibility. The reviewed EPIs have been designed in a way that tends to favour some but not all three above-mentioned objectives. In fact, a small number of the EPIs have delivered significant improvement of the environmental health of water bodies. There is a scope for *ad-hoc* adjustments through which the environmental performance can be improved.
- Frequently it is not easy to single out the actual contribution of an EPI, since they are never implemented in isolation from other policy instruments, nor should they. To some extent, innovation in EPI design and implementation can be said to be related to the idea of a policy mix, that is, a combination of instruments, each designed for one purpose. EPIs are not meant as a replacement to existing institutions but as a way for them to adapt and a step forward towards better policy responses to existing water challenges.

There are two main reasons why no relevant effect over water resources might be captured through the use of the methodological approach of the project: either the outcome was not intended or the outcome was actually intended but the EPI failed due to a wrong design of its delivery mechanism.

The real question is whether EPIs, when properly designed and implemented, can make a real contribution to improve water policy decisions. In particular, to what extent they are able to cope with the real challenges of water governance. In this report, the still preliminary answer to how EPIs can contribute to their solution is organised in three particular categories: preventing the degradation of water quality (both from point-source and diffuse pollution), tackling increasing water scarcity and improving impoverished river ecosystems.

Conclusions and lessons learnt

Despite the breath and depth of the exercise, it is not easy to draw categorical and readily transferable recommendations. The success and failure of EPIs, however defined, depends on a number of factors including water institutions and governance, in addition to how the EPIs have been designed and implemented. The attempts to draw general conclusions and lessons often end up with vague or overqualified statements that are little suitable for guiding the implementation of the EPIs elsewhere.

This first synthesis of outcomes of the *ex-post* assessment of 30 case studies is thus not intended to exhaust the topics at all, but rather to add some hypotheses to the analysis of EPIs for water management:

- As to the contribution of EPIs to avoid or mitigate the degradation of water quality derived from ***point-source*** **pollution**, it must be reckoned that normative prescriptions have traditionally played a preeminent role. The combination of command-and-control instruments (i.e. emission standards), pricing schemes (i.e. taxes) and water pollution right trading, seems to have the potential to improve water quality. Voluntary behavioural changes, however, are only possible once certain safe minimum standards are in place. In some cases, EPIs aimed at reducing water point-source pollution might have contributed to increase water prices and to reduce water demand (ironically performing better as a quantity rather than a quality instrument), besides being an important element for the financial feasibility of sanitation services.

- Regarding ***diffuse*** **pollution**, since water quality levels are the result of many individual (and scattered) decisions, tariffs or use rights cannot be defined on the basis of an effective contribution to pollutant concentrations; on the other hand, taxes do not distinguish among locations (that is, they are homogeneous). The policy mix might need to include land management provisions, for instance, to be more effective.

- To tackle **scarcity and drought**, water markets have overall managed to increase the efficiency of water allocation. They depend on the existence of marketable water use rights, freedom to agree on prices, and information such as an adequate price-revealing mechanism, since the lack of these structural requirements prevents the formation of water markets. In turn, the structure and features of water entitlements affect the way in which those markets perform. Systems that limit marketable volumes to consumed water (effective use) curb externalities and environmental threats. Systems that allow the transfer of nominal entitlements without considering effective use face problems of overallocation and, most importantly, externalities. In addition, evidence shows that trading schemes may have increased pressures over water resources (putting water into certain harmful uses that might have not been otherwise used).

- Water scarcity itself is a driving factor to increase water use efficiency, via scaling up of marginal costs, subsidies for the voluntary adoption of modern technologies, taxes or abstraction fees (although this synthesis reports on some uncertainties as to their effectiveness), etc.

- The **restoration of river regimes** has also been conducive for the implementation of EPIs. Some EPIs use voluntary agreements (based on clear economic incentives), between parties at stake. Other EPIs use subsidies aiming at improving local river conditions by setting incentives to develop environmentally friendlier hydropower generation. In addition, some EPIs have been assessed within this context, which are not explicitly linked to the mitigation of negative environmental effects from hydropower generation stations over water bodies but are part of a policy mix with potential for environmental improvements, also in water resources.

Last but not least, this synthesis report has identified a number of lessons, which will be verified in later stages of the project:

a) EPIs should be seen as part of a new approach to water policy, with the above-mentioned implications for their assessment.

b) Information quality might be a limiting factor both for EPI assessment and design; however, this is a common feature of command-and-control alternatives, and should thus not be overstated.

c) The analysis of 30 experiences should neither lead to pompous and dogmatic conclusions nor to a thorough form of relativism about the role of EPIs in contemporary water policy.

d) The failure of an EPI does not necessarily mean a flawed EPI, but rather as an opportunity to improve its delivery mechanism.

e) EPIs have traditionally been aimed at raising revenue (a financial goal) and economic development (fostering irrigation agriculture, hydropower generation, etc.). These are legitimate social objectives and can be compatible with objectives in the line of the WFD. Yet, innovative approaches are required to specifically design EPIs aimed at meeting environmental targets.

f) It may be preferable to address the trade-off of objectives of EPIs and their policy mix following a sensible approach: one goal, one instrument.

g) Rather than assessing EPIs versus command-and-control regulation, it does make sense to emphasise on the complementarity of instruments.

h) The definition of water rights is a critical issue, and not just for trading schemes.

i) Innovation is not invention. Innovative EPIs may not be 'new' EPIs but rather better designed instruments or the combination of a number of them, as it will be explored in WP4 of EPI-Water.

j) EPIs can be said to be especially effective for water policy goals when they create incentives for behavioural changes of economic agents (water users). Pricing and trading schemes (market-based instruments), are not always easy to implement (high transaction costs, equity concerns, social acceptability, institutional complex demands, etc.). The same could be said of payments for environmental services (difficult to implement in societies with advanced water regulations and institutions). These considerations do not reduce the scope for EPIs in water policy, however, but rather pose a challenge for this research project and show the added value of voluntary agreement based in mutual benefits.

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1. Background

All syntheses are carried out for a purpose, depending upon what it is to be learnt. Secondly, syntheses are forms of metabolism, taking the useful from the irrelevant and converting the valuable findings into lessons learnt to inform water policy making. As such metabolism, a synthesis does consequently require elapsed time.

This first synthesis (D3.2: 'Comparative analysis') is therefore the output of Task 3.3 of the project and will guide, together with other outputs (D2.3: 'Review of the framework and toolbox', for instance), the work of the research consortium during the rest of the project. This report has sought to draw out some hypotheses as to the circumstances in which one or another form of EPI is appropriate and the conditions under which that form of the EPI would be more effective to tackle water policy challenges. Yet, the reader should bear in mind that this is a very early synthesis. It should not be seen, therefore, as a final say. This synthesis, as a matter of fact, will be refined or, where necessary, substantially amended, during the next two years of the project timespan.

Thus, D3.2 is not an output that seeks to set out the basis for decision makers to choose a particular form of EPI in specific circumstances, and the conditions required for that EPI to be adequate and successful. What it actually does is to try to lay down a benchmark for other deliverables of the project, which will build upon the assessment developed within WP3 (*ex-post*) and WP4 (*ex-ante*).
This synthesis does not only benefit from the reflection on the assessment of 30 case studies (20 from Europe plus 10 developed by the members of the 'Inspiration beyond the European Union' group). It also feeds on the fertile discussions held between EPI-Water consortium partners and other attendees to the First FP7 EPI-Water Conference ('Understanding the application of economic policy instruments – EPIs – in Water Management: Review of Empirical Evidence, Experiences and Lessons Learned from Europe and Elsewhere'), recently held in Berlin (January 26th-27th, 2012). This includes suggestions and insightful comments from the Policy Think Tank (PTT) members.

EPI-Water is one of a few studies conducted in Europe and elsewhere using an evidence-based approach to the assessment of EPIs for water management. The breath of the exercise is remarkable: the performance of 30 EPIs has been analysed and assessed against environmental, economic, social, institutional, and political criteria. The reader will find conclusions built on the *ex-post* assessment of case studies from Cyprus, Denmark, France, Germany, Hungary, Italy, the Netherlands, Spain, Switzerland, and the United Kingdom, as well as from Australia, Chile, China, Israel, and the USA. A wide range of EPIs has also been covered: water-pricing schemes (tariffs, environmental taxes, environmental charges or fees, subsidies on products and practices), trading schemes (tradable permits for abstraction and pollution), cooperation mechanisms and liability instruments.

2. Introduction

Economic Policy Instruments (EPIs) are those incentives designed and implemented with the purpose of adapting individual decisions to collectively agreed goals of water policy in the European Union.

As to the definition of the EPI itself, NCEE, 2001 states "[…] economic incentives are defined broadly as instruments that use financial means to motivate polluters to reduce the health and environmental risks posed by their facilities, processes, or products". This stresses upon the idea of incentives, motivation, and voluntary choice, which will be pervasive in this text. Stavins (2001, p. 1), in turn, define market-based instruments (MBI) as "regulations that encourage behaviour through market signals rather than through explicit directives […]"[2]. More recently, ONEMA (2009) explained "the rationale underlying their application in the field of the environment includes modifying the behaviour and decisions of stakeholders and individuals […]".

Kraemer *et al.* (2003, p. 3) states: "In cases where the primary purpose of an economic incentive is to create the necessary incentives for behavioural changes, the mechanism can be categorized as an incentive-based instrument". This definition is very clear; yet, it gives the impression that Kraemer *et al.* are thinking of a second meaning of EPI. This can be found in page 4: "When the primary aim of an environmental charge or tax is not to create incentives but to raise revenue, the relevant distinction lies whether the revenue is earmarked or simply added to the general government budget". It will be argued in this text that financial mechanisms, such as the ones described in the second definition by Kraemer *et al.* are of critical importance for EPI implementation but may be seen not as EPIs themselves. On the other hand, the discussion about earmarking can also be misleading. If fiscal revenues from a cost-recovery mechanism are earmarked for environmental purposes, the EPI will be the latter and not the former.

Very recently, OECD (2011, p. 6) provided the following definition for economic instruments: "policy tools which influence behaviour through their impact on market signals rather than explicit regulation or 'command and control'".

The *ex-post* assessment of environmental outcomes is related with the main question about EPI for water management: how to adapt those individual decisions to shared

[2] In this sense, EPIs are not the same as Market Based-Instruments (MBIs). Actually, the former refers to a broader category of instruments covering not only intended behavioural changes through market signals in a desirable competitive context (pricing and trading schemes) but also through cooperation and voluntary agreements.

goals for example as defined in terms of a certain desired quality of the water environment.

In this report, the 30 case study reviews from the *EPI-Water Deliverable 3.1 Review Studies*[3] are synthesized and cross-compared to extract a set of common features from and formulate hypotheses about the conditions under which EPIs contribute to sustainable water management. This synthesis first draws lessons from an *ex-post* review of the analytical framework for the assessment of EPIs that was developed in WP2. The analysis continues with a thematic comparison of the 30 case studies organized around three categories: preventing the degradation of water quality, tackling increasing water scarcity and improving impoverished river ecosystems. It further includes a set of conclusions.

Context for water policy intervention

Water is a fundamental resource that sustains life of all human beings. However, there is a growing concern about water quality and availability in some parts of Europe. While water demand is constantly increasing, supply of water in the required quality and quantity is stressed by the accumulation and intensification of diverse factors such as unsustainable agricultural practices and urban activities, inefficient allocations and un-adapted governing institutions. In addition to the already uneven distribution of water resources in Europe, climate change, by inducing alteration of rainfall patterns, will further aggravate reliable water availability in currently water poor regions. Thus, measures need to be taken to address these issues and to prevent an unsustainable resource use.

The European Union is addressing these challenges by implementing innovative Directives, e.g. the Water Framework Directive (WFD), which was adopted in 2000 and aims at achieving a good ecological status of water bodies by 2015. A number of Directives, which are now included in the WFD, address point source pollution, such as the Urban Wastewater Directive (91/271/EEC), the IPPC Directive (2008/1/EC) or the Directive on Dangerous Substances (76/464/EEC). The Nitrates Directive (91/676/EEC) is the key to protecting water sources from agricultural diffuse pollution by changing farming practices. The Bathing Water Directive (2006/7/EC) has the purpose to preserve, protect and improve the quality of the environment and to protect human health. The Floods Directive (2007/60/EC) addresses the assessment and management of flood risks, while the communication on scarcity and droughts (COM (2007) 414) presents a set of policy options to increase water efficiency and water savings.

[3] The full case studies undertaken to fulfill the reporting requirements of Deliverable 3.1 of WP3 and the report containing only their executive summaries can be accessed in the public area of the EPI-water project web site at: http://www.feem-project.net/epiwater/docs/epi-water_DL_3-1+DL6-1.zip

Further, "*The Blueprint to Safeguard Europe's Water*", which will be published by the end of 2012, will assess the implementation and achievements of the current water policies in Europe and will set the basis for future water policy in Europe.

EPI defined

The essential characteristic of an EPI is that it is an incentive deliberately designed and implemented in order to make individual economic decisions compatible with some policy goal. Economic instruments for sustainable water management, as considered in EPI-Water are consequently designed and implemented both to induce some desired changes in the behaviour of all water users in the economy (individuals, firms or collective stakeholders) and to make a real contribution to collectively agreed water policy objectives (NCEE, 2001; Stavins, 2001; Kraemer et al., 2003; UNEP, 2004; PRI, 2005; ONEMA, 2009; OECD, 2011).[4] The broad categories of EPIs which apply to water management and that have been identified in the project are outlined in table 2.1.

Table 2.1 Broad categories of EPIs used in EPI-water project

Type of instrument		Function / main purpose
Pricing	*Water tariff*	Price to be paid for a given quantity of water (or sanitation service), either by households, irrigators, retailers, industries, or other end users. Although prices obviously contribute to collect financial resources for the operation of a given water service (that is, they are also a financial instrument), in strict sense they can only be said to be economic instruments should they create incentives to promote water use efficiency, via deliberate changes in consumer behaviour.
Pricing	*Environmental tax*	Compulsory payment to the fiscal authority (whichever it is), where the benefits provided to the taxpayer are not directly linked to the payment (that is, when there is no immediate real consideration). Thus, it is an unrequited payment (i.e. there is no link between the payment and the water service rendered). They are levied on the measured or estimated effluents of noxious or other harmful substances to water bodies, the effluent collection and treatment, water abstraction, etc. They are considered economic instruments (besides their revenue-raising financial function), as long as they intend to modify behaviour.
Pricing	*Environmental charge (or fee)*	Compulsory payment for a service to the competent body. As opposed to taxes, charges or fees are requited payments; their function, though, as economic instruments, is alike.
Pricing	*Subsidies on products*	Unrequited payments from government bodies to producers, with the objective of influencing their levels of production, their prices or the remuneration of inputs. They can also be paid to households to subsidy consumption. They are said to be environmental subsidies (and therefore EPIs for water management), if reducing the use of some proven, specific negative impact on the water environment.

[4] Within the scope of EPI-Water and the assessment of environmental outcomes, the effects of water policy on other sectors was also assessed (it is of paramount importance to do that as part of the assessment of instruments). On the contrary, the effects of other policies on water was not analysed since this is part of the analysis of scenarios in which EPIs were assessed.

	Subsidies on practices	Unrequited payments from government bodies to producers to increase the attractiveness of more sustainable production processes that limit negative impacts on water sources or produce positive environmental externalities.
Trading	*Tradable permit for abstraction*	Right or entitlement of an individual (either natural or legal person) to use water from a given source (i.e. river, pond, stream, aquifer, etc.), under the conditions and with the attributions resulting from law. "Water use" must indeed be read in a broad sense: consumption, abstraction, discharge, etc. Water rights, within trading systems, can be exchanged thus creating incentives to improve allocation (efficiency) of water quantity amongst different sectors (including the natural environment).
	Tradable permit for pollution	Right or entitlement of an individual (either natural or legal person) to pollute the water environment under certain limitations and conditions, through the discharge of a toxic substance or wastewater effluent. Tradable pollution permits, once exchanged on a voluntary basis, may create incentives to abate pollution at an aggregate level.
Cooperation[5]		Negotiated arrangement between parties to promote good practices for the reduction of pressures on water resources often linked to subsidies or compensation schemes. Settlements to preserve water resources and to share benefits thus obtained (i.e. voluntary agreements, including PES schemes).
Risk schemes	*Insurance*	Insurance (risk management instrument primarily used to hedge against the risk of a contingent, uncertain loss, for example in the event of flood or drought)
	Liability	Offsetting schemes where liability for environmental degradation leads to financial payment that is allocated to compensation for environmental damage.

Pricing. Prices need to be understood in a broad economic sense as a signal of the opportunity cost of the different available alternatives. A subsidy is clearly a price to be paid, foregone or received depending on the context and the decision taken. At the end of the day, a subsidy is but a price in which someone other than the recipient (usually a public body) pays part of the cost of a commodity or a service or a production input. As in Weitzman (1974), the government may choose to set prices and leave quantities to economic agents (if prices are adequately designed, the actions taken by individuals in accordance with their own interests, preferences and endowments, would lead to the desired outcomes of water policy). There are many ways to put a price on water decisions (charges, tariffs, taxes, and indeed subsidies), and many other ways to design each instrument (multipart tariffs, deposit refund systems, taxes on products instead of pollutants, flat rates, subsidies for capital installation, on yields or on practices, etc.). The way these pricing schemes are designed is essential for their effectiveness as a means to coordinate individual

5 For the purposes of this project and because of its current relevance as an instrument for water policy in Europe, Voluntary Agreements (VA) have been included (under Cooperation) as an ad-hoc item in the broad categories of EPIs. It is worth noting, though, that there is an on-going debate in the literature about whether voluntary agreements (VA) can be regarded as a "pure" economic policy instrument or not. Environmental VAs are commonly defined "as an agreement between a government authority and one or more private parties with the aim of achieving environmental objectives or improving environmental performance beyond compliance to regulated obligations. Not all VAs are truly voluntary; some include rewards and/or penalties associated with participating in the agreement or achieving the commitments" (Gupta et al., 2007). Some economists interpret the "Voluntary" nature of the agreements as a version of regulation and therefore, argue that they do not belong to the economic policy instruments category.

decisions with the collective goals of water policy. According to Weitzman, an important drawback of pricing schemes is the uncertainty associated to the environmental outcomes they deliver.

Trading. The water authority, though, may choose to set quantities instead of prices. In this case the solution for the government consists in defining first the quantity of water services than can be produced anytime anywhere. Once these quantitative limits are defined they are converted into property rights that can be traded within the limits defined by the water authority. Environmental outcomes are guaranteed as far as the set of property rights is properly defined and enforced (and they are compatible with the desired status of water bodies).

Cooperation. A category, which is not included in the "prices vs. quantities" approach, is that of cooperation (instead of competition) among water stakeholders (and water users) to preserve water resources and to share benefits thus obtained (i.e. voluntary agreements, including PES schemes). Pricing and trading stem from competitive decisions based on individual choices (or what is called market-based mechanisms). Water users and stakeholders can cooperate in many circumstances (instead of competing) and agree on mutually beneficial actions in order to conserve assets, share benefits, etc.

Risk schemes. The final category of EPIs must include provisions on whom and how to bear the risk of decisions concerning water, on how these risks are shared (or not) and whether these risks can be transferred. It includes responsibility and liability regimes as well as insurance schemes. All decisions concerning water use and water conservation entail a certain level of risk (drought and floods – hydrological uncertainty; crop failure, pests, fires – agronomic uncertainty; irreversible damages, salt intrusion, pollution, price volatility, etc. EPIs may consist in a provision on who bears the risks and to what extent anyone is responsible for their own economic decisions (objective or subjective liability regimes, responsibility rules), under a specific institutional setting to share risks (damage compensation funds, drought insurance).

EPI case studies assessed during WP3

The 30 case studies reviewed during WP3 cover a selection of different EPIs addressing specific, recurring themes. Table 2.2 displays the themes and locations of each case study.

Table 2.2 List of investigated EPIs

#	Name of EPI case study	Location	Country code	Partner
1	Water transfers in the Tagus River Basin (Spain)	Tagus Basin, Spain	ES	IMDEA
2	Lower Ebro (Spain): Voluntary agreement for river regime restoration services	Lower Ebro Basin, Spain	ES	IMDEA

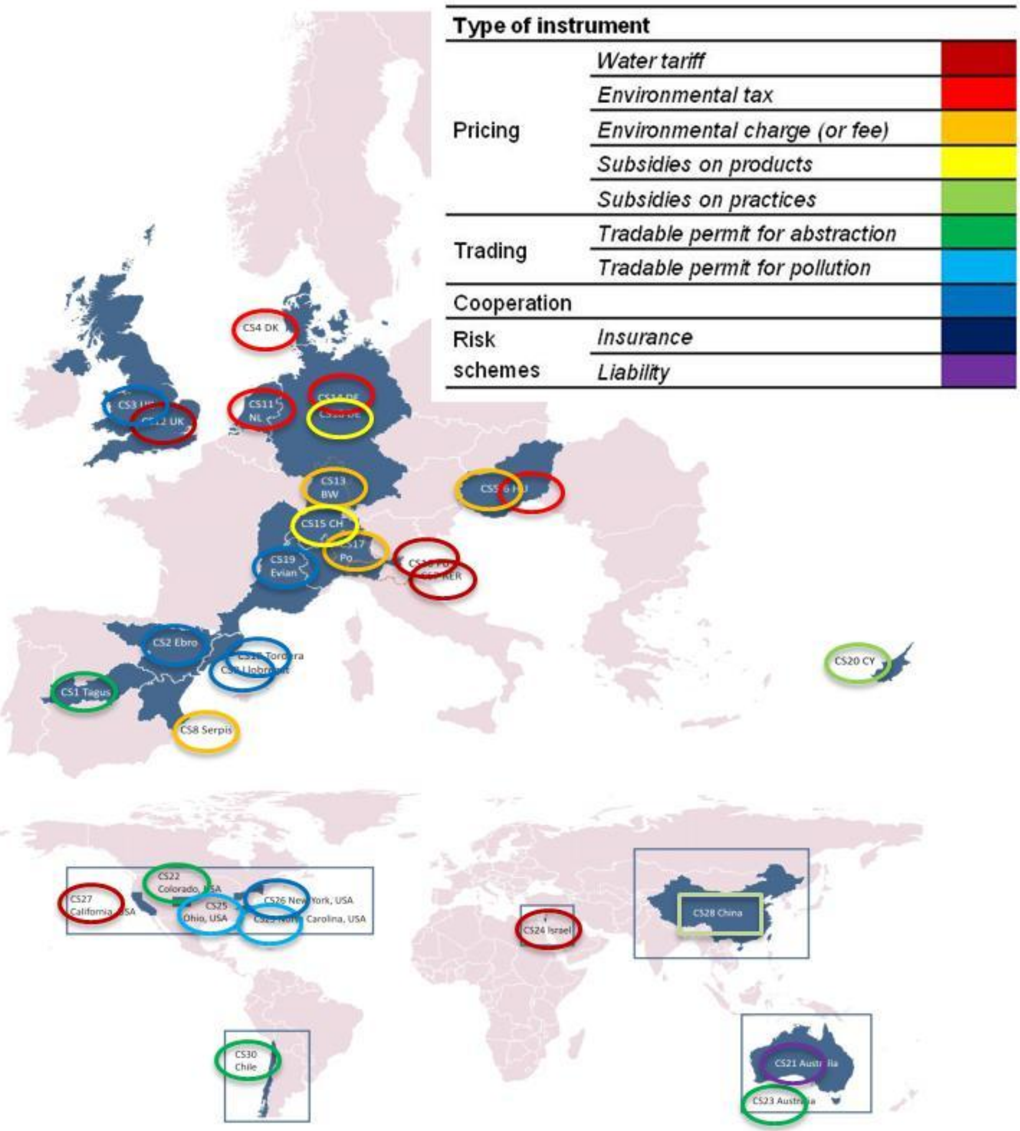
3	Cooperative agreements between water supply companies and farmers in Dorset	United Kingdom	UK	MU
4	The Danish Pesticide Tax	Denmark	DK	NERI
5	Water Resource Fee – Hungary	Hungary	HU	REKK
6	Water load fee- Hungary	Hungary	HU	REKK
7	Water tariffs in agriculture – Emilia- Romagna case study	Emilia Romagna, Italy	IT	UNIBO
8	Increase in the pollution charge at Serpis River Basin	Serpis Basin, Spain	ES	UVEG
9	Voluntary intersectoral water transfer -Llobregat River Basin	Llobregat Basin, Spain	ES	UVEG
10	Negotiation and monetary incentives to promote the use of reclaimed water at Tordera River Basin	Tordera Basin, Spain	ES	UVEG
11	Groundwater tax in the Netherlands	The Netherlands	NL	WU
12	Payment by the drop: The move to water metering in England and Wales	United Kingdom	UK	WU
13	Water Abstraction Charges and Compensation Payments in Baden-Württemberg (Germany)	Baden-Württemberg, Germany	DE	Ecologic
14	Effluent Tax in Germany	Germany	DE	Ecologic
15	Green Hydropower in Switzerland	Switzerland	CH	Ecologic
16	Water tariff system in Italy and tariff structure in the Region Emilia Romagna (RER)	Po Basin, Italy	IT	FEEM
17	Green energy certificates and compliance market	Po Basin, Italy	IT	FEEM
18	Subsidies for ecologically friendly hydro-power plants through favourable electricity remuneration in Germany	Germany	DE	ACTeon
19	Financial compensation for environmental services: the case of Evian Natural Mineral Water	Evian, Haute Savoie, France	FR	ACTeon
20	Subsidies for Drinking Water Conservation in Cyprus	Cyprus	CY	NTUA
21	Salinity offsets in Australia	Australia	AU	
22	The efficient water market of the Northern Colorado Water Conservancy	USA	US	
23	The role of the Unbundling water rights in Australia's Southern Connected Murray Darling basin	Australia	AU	
24	Price setting of urban water under centralized management	Israel	IL	
25	Great Miami River Watershed Water Quality Credit Trading Program	USA	US	
26	New York City watershed agricultural program	USA	US	
27	Water budget rate structure: experiences from urban utilities in California	USA	US	
28	Case study China	China	CN	
29	Nitrogen Permit Trading in North Carolina's Neuse River	USA	USA	
30	The Chilean Water Allocation Mechanism, established in its Water Code of 1981	Chile	CL	

Rationale for the selection of case studies

The criteria employed for the selection of the EU case studies include the following elements: the categories of EPIs, geographical coverage, economic sectors and pressures targeted by the EPI. The complete submission of deliverable (*DEL3.1*) of the project contains detailed descriptions of all the proposed case studies.

The EU selection illustrates a wide geographical distribution of the proposed case studies, covering: Spain (ES): 5; Italy (IT): 3; Germany (DE): 3; The United Kingdom (UK): 2; Hungary (HU): 2; and, Denmark (DK), The Netherlands (NL), Switzerland (CH), France (FR) and Cyprus (CY) with one each respectively.

Map 2.1: geographical distribution of the EU and IBE group case studies and distribution of EPI categories



The EPIs covered in the case studies can be grouped into the following types: pricing (water tariff, environmental tax, environmental charge, subsidies on products, subsidies on practices), trading (tradable permit for pollution, tradable permit for abstraction), cooperation and risk schemes (insurance and liability). The above map 1.1 also illustrates the general range of EPIs considered under each of the identified EPI categories.

The selection of case studies places an emphasis on the types of EPIs that have been usually applied across the EU thus allowing for comparative analysis of the results between case-study areas. Three case studies out of the 20 proposed illustrate examples of the application of water tariffs across the EU (IT and UK). Five studies evaluate the set-up of cooperation in different locations (UK, ES and FR). Subsidies, either on products or on practices, are covered in three case studies (CH, DE, and CY). In the EU, there are no explicit examples on tradable permits for pollution control, which is a reflection of the infrequent or just simply non-adoption of these schemes in Europe.

Regarding the application of innovative water policy instruments, 10 additional studies from beyond of the EU have been undertaken to illustrate experiences distinct from the EU ones. As such, the Inspiration Beyond Europe (IBE) expert group has delivered experiences on such case studies. The following types of instruments have been covered by the IBE expert group that we consider are of special interest in Europe: tradable permits for pollution control (Australia – salinity offsets - and the US: Ohio and Northern Carolina), tradable permits for water (use) rights (Chile, Northern Colorado in the USA and the Murray-Darling basin in Australia) or innovative pricing instruments (Israel and the US). A PES scheme is presented for New York State (USA). In addition a very comprehensive assessment of EPIs in China has been provided (pollution charges, abstraction charges, irrigation pricing, phasing out of farm input subsidies, etc.).

Beyond geographical location and broad categories of the EPIs, the WP3 case studies can also be categorized by industrial sector, i.e. hydroelectricity or agriculture, and by pressure/water issue, i.e. water quality or water scarcity. Tables 2.3 and 2.4 respectively display the allocation of cases among these different themes

Table 2.3 Case studies by economic sector

Sector	Case Studies
Agriculture	4, 7, 23, 25
Agriculture and urban	1
Agriculture and water utilities	3, 29
Agriculture, municipality and industry	10, 26
Agriculture, domestic and tourism	20
Agriculture, industry and environment	11, 19, 21, 28
Urban/ Municipal	9, 12, 24, 27
Industry and water utilities	6
Water utilities (incl. WWT)	8, 14, 16
Hydropower	2, 15, 17, 18
All sectors	5, 13, 22, 30

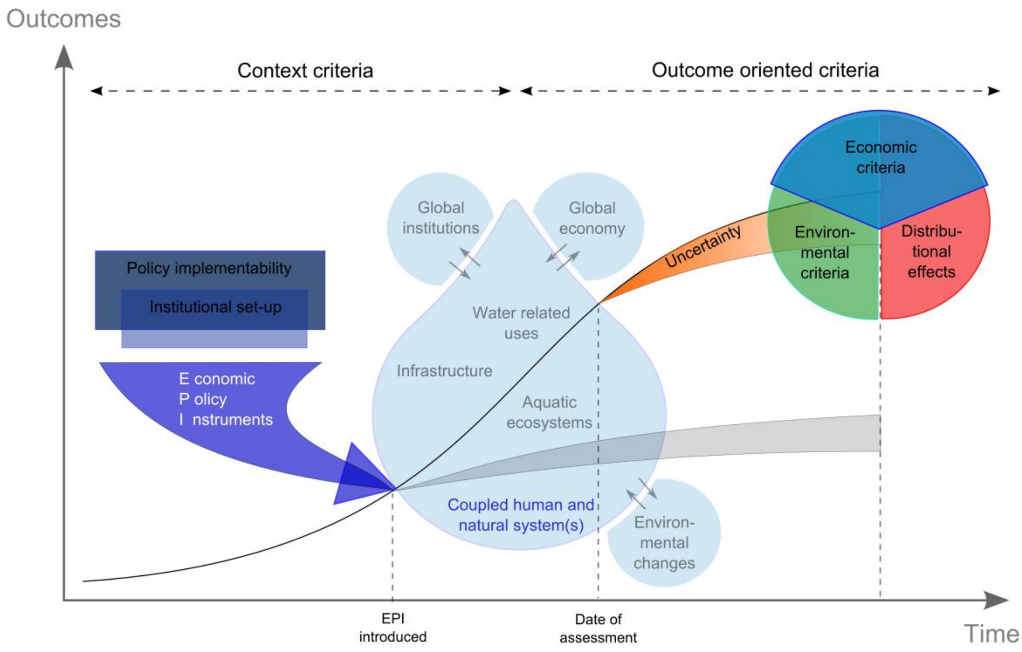
Table 2.4 Case study by main water management/policy issues

Pressures/ water issues covered	Case Studies
Water quality	3, 4, 6, 8, 13, 14, 19, 21 , 25, 26
Water quantity	1, 5, 7, 9, 10, 11, 12, 16, 20, 22, 23, 24, 27, 29, 30
Hydro-morphology	2, 15, 17, 18

Overall Assessment Framework

To strategically extract comprehensive conclusions and common lessons learned from the case studies, the review exercise was guided by the Assessment Framework (AF), which was developed in WP2. The AF takes into consideration the multiple dimensions of the EPIs reviewed and offers a universal set of criteria for analysing and comparing the results of the EPI case studies (Figure 1.1).

Figure 1.1 Conceptual schematic diagram of the EPI assessment framework



*In general, it is difficult to find an objective and widely-accepted measure of the performance of EPIs Some people may be interested in an environmental outcome (e.g., water quality); others will be interested in social impacts (e.g., the incidence of higher prices for domestic water use); still others will care more about economic efficiency (e.g., the value of crops grown with a water market). The assessment framework clarifies (and where possible, quantifies) the effectiveness of each EPI according to seven criteria: institutional background, environmental outcomes, economic outcomes, transaction costs, distribution effects, uncertainty, and policy implementation. These seven criteria guided the synthesized conclusions of the use of the EPIs applied to sectors and water pressures.

Tasks and criteria relate in the following way: EPIs target objectives by producing outcomes on environmental and economic dimensions. These outcomes are associated with distribution patterns that affect the social impact of an EPI. Impacts for all three of these criteria are subject to the influence of institutions, which affect the process of implementing the EPI and the transaction costs associated with design, implementation and operation. Observed outcomes reflect one realized set of potential outcomes. Future circumstances may not produce the same outcomes (for good or ill), so it's necessary to understand how the range of outcomes may vary with uncertainty.

The description of the seven criteria and a selection of the guiding questions recommended to follow during the assessment of the case studies are presented in the following:

Environmental Outcomes

EPIs target water policy objectives (e.g., reduce water demand or maintain WFD quality standards) or increase the social value of water by changing incentives to direct behaviour towards collective goals. EPIs that target environmental outcomes have been assessed by comparing actual outcomes with alternatives (no action or regulation, for example) and evaluating positive and negative side effects. This criterion considers the response of economic agents to EPIs in terms of changes in demand for water services; the impact of these changes on the ecological status of water-related ecosystems, and the value of the environmental goods and services from these ecosystems to humans.

Economic Outcomes

The economic assessment evaluates the EPI based on efficiency using a cost-benefit analysis (CBA) principle that integrates consideration for incomplete and/or unreliable economic estimates. In addition, EPIs have been evaluated according to cost effectiveness, cost savings, distributional effects (e.g. examining the equity and ethical considerations from this distribution), risk reduction, cost recovery, and incentive compatibility (including asymmetric information issues). Effects directly linked with environmental outcomes have been used as an input to the analysis in this criterion.

Distributional Effects and Social Equity

The distribution of goods and burdens across different groups affects social equity and acceptability of EPIs. There are many arguments made in the social justice literature as to what constitutes a 'just' distribution. In EPI-Water we focus on social equity and take it to mean reducing the inequalities between stakeholder groups. This criterion focuses primarily on assessing the nature of the distribution, highlighting inequalities in the allocation of goods and burdens as a result of the implementation of EPI. The assessment considers both proxy indicators based on quantitative data and quantitative subjective measures of well-being (Stiglitz Commission 2009). These results are assessed by comparing pre- and post-EPI implementation conditions.

Institutional Background

Institutions are the formal rules and informal norms that define choices by affecting the cost of exchange (transaction costs) and production (transformation costs) (North 1990). Most institutions are difficult to describe, highly adapted to local conditions, and effective in balancing many competing interests. Institutional constraints vary in strength, depending on their level. For the application of this criterion, institutions and transaction costs have been separated in our analysis by associating institutions with exogenous impacts on EPIs and TCs with the fixed costs of implementing an EPI and variable costs of using it. A water market, for example, is established with fixed TCs and operated with variable TCs, but both are affected (positively and negatively) by institutions. These effects should be kept distinct from the impacts of EPIs that create/modify institutions (e.g., new markets or tax adjustments, respectively) or influence the institutions of existing markets and bureaucracies, choices and behaviour (e.g., water law, policy or administration).

Policy Implementability

As part of the policy cycle, the *policy implementation phase* is critical as the theoretical ideas of the policy (instrument) need to be adapted to match practical realities. It is not a clear-cut and automatic process which occurs following the adoption of the precedent legislation but may be limited by a number of factors which affect the ability of the political system to put policies into effect to achieve the desired outcomes.

The application of this criterion identifies and defines key factors that are important for implementation of EPIs and recommends methods for their measurement and elicitation for their evaluation. The assessment draws upon the analysis of four main themes, namely the adaptability of the EPI, public involvement, institutional factors as well as the influence of external factors, such as EU sectoral policies on the EPI implementation.

Transaction Costs

Transaction costs (TCs) from implementing or using EPIs are different from typical direct costs. Krutilla and Krause (2010) examine "TCs related to the creation, implementation and operation of environmental policies." Their analysis refers to ex-ante TCs (e.g., negotiating new property rights) and ex-post TCs (e.g., monitoring costs). They also refer to "factors affecting the magnitude of TCs" such as cultural norms, the state of technology, etc. These exogenous factors affecting EPIs are examined under the institutional background criterion. Krutilla and Krause's classification of TCs has been used- noting that ex-ante TCs are equivalent to fixed costs and ex-post TCs are equivalent to variable costs associated with the EPI. TCs have been identified by examining the flow from design and implementation (ex-ante) to monitoring and enforcement (ex-post). Asymmetric information falls under TCs in two ways. Ex-ante and ex-post TCs can change the information environment (e.g., establishing and running a monitoring program). Asymmetric information can impose visible and invisible TCs, e.g., the costly change in behaviour in response to incomplete information.

Uncertainty

An EPI's impact on any criterion is subject to uncertainty from imprecision (missing knowledge, estimation, inaccuracy or ambiguity), complicated interactions among policies, and/or future costs/benefits. For EPI-Water, we propose to use the pedigree analysis inspired by van der Sluijs et al (2005). The pedigree represents an explicit account of the quality of information and the processes underlying the knowledge production process. The pedigree criteria are assessed through expert judgement, using qualitative statements.

3. EPIs and the goals of Water Policy

The main concern of EPI-Water lies in the goals of water policy and not in the instrument itself. Any assessment of the convenience of a more extended use of incentives, rather than prescriptions, needs to be based upon the potential of EPIs to make a real contribution to the actual goals of water policy. For that same reason, for example, price levels cannot be claimed to be right or wrong; rather, pricing schemes can be said to be adequate or inadequate to help achieving policy goals (i.e. reducing water scarcity, increasing resilience to extreme events or restoring and protecting the status of water resources).

Although arguments in favour of using EPIs to make water decisions more flexible and adaptable have been put forward, it is expected that such **arguments in favour or against an extended adoption of EPIs to be based on proven facts and testable empirical evidence.** The search for those experience-based judgements is built on the *ex-post* assessment of a significant number of EPIs in Europe and beyond carried out so far in this project.

Nevertheless, reaching a set of strong, precise and easily transferable conclusions is an elusive task. Conclusions depend on many framework conditions, such as the institutions in place and the driving factors behind the EPI adoption. Furthermore, once these conclusions are widened to a more general framework they become contingent and less accurate.

One must also be aware that established instruments were assessed through criteria stemming from a new water policy approach. Principles guiding the *Assessment Framework* (EPI-Water DEL2.3) were not in place when the majority of the EPIs analysed was implemented and the approach of water policy has changed so far in many essential features.

An important problem to be taken into account in this synthesis is the fact that the interest does not lie in the assessment of existing EPIs for the sake of it but rather on lessons that can be drawn towards a better response to current and future water policy challenges. Therefore, the main concern is not only to sort out the real contribution of prevailing EPIs to the objectives they were designed for but on their potential to serve the goals of contemporary water policy.

In other words, while the project and the *Assessment Framework* are inspired, for example, in principles such as water resources required to be managed as an economic asset, many EPIs considered so far were originally conceived to maximize water service flows available to an economic use (such as hydropower or household demand). Even in these cases, as below, there are important lessons to be drawn from past experiences.

Water policy is never defined by just one objective. In fact it is a mix of at least three main objectives: some environmental targets, some development goals, and the guarantee of financial sufficiency. Ideally, any water policy must result in a simultaneous contribution to the three objectives and help improve water resources, foster economic performance, and be financially feasible when not profitable. Yet, the relative importance of each one of these objectives has changed through time. While financial objectives are instrumental, not so long ago developmental objectives were called to play the leading role (and success in water policy was dependent on the success in coping with the increasing water demand from growing urban areas, irrigated agriculture and other water using economic activities). Today, the importance of environmental objectives has been upgraded and success in water policy is measured by the ability to coordinate all the demands of water services in the economy with the improvement and adequate conservation of water sources.

The actual purpose of each particular EPI and its potential to contribute to the specific objectives of water policy – being it environmental, developmental or financial - needs to be recognised. Case studies considered in EPI-Water show important contributions of water policy to promote and sustain particular economic activities (such as agriculture, hydropower or tourism development) as well as to make the provision of water and sanitation services financially sustainable. **There is a relevant number of what one could call successful EPIs but just a few were linked to significant improvements in the water environment.** However, it was identified that there is still room for innovative EPIs designed *ad hoc* to serve environmental objectives and, in particular, to manage the challenge of coping with increasing water scarcity, droughts and flood risk, poor water quality and degraded water ecosystems.

EPIs are never implemented in isolation. As any other policy instrument they are part of a policy mix jointly with command-and-control instruments and, although not commonly, with other EPIs. That is to say that the intended and effective role played by any EPI in the policy mix needs to be considered. This is a good reminder that EPIs should not be seen as a replacement for existing institutions but as a way for them to adapt and as a step forward towards better policy responses to existing water challenges. The real question becomes what contribution EPIs can really make to improve water institutions and current water policy mix. Part of the answer needs to be found in the particular goal to which existing EPIs were designed and implemented. **Evidence shows that some EPIs, such as tariffs and charges, have been successful as financial cost recovery mechanisms and that water markets have resulted in effective means to foster agricultural and hydropower generation.** Moreover, no equivalent advances have been experienced so far in the effective contribution of existing EPIs to guarantee the protection of water resources and to deliver positive environmental outcomes. **Experience gained in financing and sectoral development can probably be used to improve EPIs purposely designed to cope with managing water resources sustainably.**

The remaining part of this section illustrates a comparative revision of EPI-Water WP3 (*ex-post* assessment) case studies in order to solve some critical questions arisen from the previous reflections and from the discussion of results with IBE experts and PTT.

Why some EPI assessments have not resulted in convincing evidence on their contribution to the sustainable management of water resources?

The necessary condition for an EPI to have a direct effect over the status of water resources is to somehow change the demand for water: reducing water use or wastewater loads, installing more effective water use devices, improving water use practices, engaging in water restoration measures, etc. There are two main reasons why no relevant effect over water resources might be captured through the use of the methodological approach of the project: either the outcome was not intended (i.e. the environment is a good pretext to make taxes acceptable and even for rent seeking and regulatory capture) or the outcome was actually intended but the EPI failed because of a wrong design of its delivery mechanism (a flat rate instead of a marginal price, too much moral hazard, no monitoring and enforcement in place, too low prices and too inelastic demand, the one who pays is not the one who cares for pollution or for water use…). This would be the case of a wrong (ill-defined) EPI, but an EPI after all.

Yet, in the evolving and uncertain scenarios where water policy needs to be assessed it may be hard to ascribe observed environmental outcomes to specific policy instruments in place, which is also the case for traditional command-and-control instruments. In practice, though, searching for answers has actually proved to be a real challenge hardly leading to accurate and robust responses and, very often, only to approximate (when not vague) answers. This may include a wide-ranging set of fairly common combinations of lack of data, ill-defined objectives, poorly designed instruments, lack of transparency and many other actual barriers impeding to follow through the roadmap that was presented in the *Assessment Framework*. Nevertheless, the lack of information should not be seen as the only hurdle to effective water policy (and EPI) design and analysis. It is not a valid argument to show the supremacy of command and control over EPIs since both kinds of instruments rely, *a priori*, on the same information basis.

Within this context, some other reasons, identified in the literature (OECD, 2011), may be found to be more significant, as they compromise the potential of the emerging interest in water policies buoyed on innovative EPIs. For instance, the fact that policy approaches relying more on individuals' freedom and decisions as a result of rational choice may lead to more uncertain outcomes if compared to legally prescribed and properly enforced actions.

A number of results obtained in the case studies help illustrate the rationale to raise doubts about many positive environmental effects that are usually taken for granted. One of them is that water markets always allow for more efficient allocation of water resources without any additional detrimental effect over the environment. Others are that investing in environmental protection is all that is needed to improve the status of watercourses, or that saving water at one point will always reduce water pressures and improve the status of all water bodies.

In what follows we discuss how far we have been able to progress in looking for a precise answer to what contribution to the sustainable management of water resources is delivered by the EPIs analysed in the project and, although the overall balance is basically positive, we place more emphasis on the most arguable issues; at the end of the day, these are also those offering a higher potential for learning.

What kind of water policy goals were the assessed EPIs expected to serve?

To answer this question one needs to be aware of the fact that the contemporary perception of what water policy is all about is still recent and not fully adopted by existing institutions either in Europe or abroad. Contemporary water policy consists in a mix of two targets: improving and protecting water resources, on one side, and finding the way to progress in the production of goods and services in the economy without generating additional damaging effects over the environment, on the other. The main emphasis may be placed on one target or the other but in any case failure or success needs to be judged in terms of the real contribution to the sustainable management of water sources (or the WFD understanding, in terms of how the status of water bodies has changed as a result of EPI implementation).

However, this approach to water policy has not always been in place. Evidence collected in EPI-Water WP3 *ex-post* assessments shows that the new approach of water policy has not yet been completely assumed by all real-world institutions and stakeholders involved in water policy. In fact, many of the assessed EPIs had been in place long before Good Ecological Status was set in 2001 as the overarching aim of European Water Policy, or the prevalent importance of water ecosystems and the services they provide was realised by the UN Millennium Development Goals, or the most fundamental need to consider water as an economic good was mainstreamed for all different water policy facets in the Declaration of Dublin in 1992. In many of the reviewed case studies these objectives were not recognized as the central criteria for their initial design and objective setting. Nevertheless, the Assessment Framework developed for this project was used to assess water EPI's objectives and means to reach water policy goals takes them into account.

The fact that we are assessing "old" material with new (or even emerging) approaches became more than evident in many case studies. For example, even in some recently implemented water policy EPIs (both within and outside the European Union), the intended and actual environmental outcomes had not even been considered as something relevant for the design or the implementation of those instruments (this is evident, for example, in CS#30, on the Chilean water market).

For the same reason, intended environmental outcomes are imprecise in many case studies, if existing at all, and information systems originally designed for their assessment were not supposed to provide any relevant information in that respect.

Nonetheless, this exercise is not a sterile one provided it allows to draw the relevant lessons and recommendations to improve current instruments and to the design of innovative EPIs in later Work Packages of the project.

What is the real purpose of each one of the EPIs analysed?

Practical examples do not always fit nicely with the shared perception that EPIs are definitely means to an end. Very often, ends cannot be easily identified (not to mention if it is in terms of the collectively agreed status of water bodies). Clear instruments without any identifiable purpose (at least in what concerns water policy) are nothing more than a rarity. Some EPIs, for example, have been able to survive long after the obsolescence of the original objectives for which they were conceived. See, for example, the water load and the water resource fee in Hungary (CS#5 and CS#6), which were already in place before Hungary's accession to the EU, and even to the economic downturn that came along the evolution from a centrally-planned towards a "free" market economy. The survival of these instruments owes more to their convenience to raise public revenue rather than to the social and political commitment to improve water governance and preserve the environment.

The role of these EPIs for the environment is not completely irrelevant (as water prices in Hungary are higher than in other water-abundant countries), but the main lessons to be learnt are mostly related with how a probably well-meant instrument has been gradually transformed to serve purposes that are now drastically different from initial ones. As a matter of fact, these objectives may not even be linked to cost recovery, since revenues are not earmarked anymore to water works or water conservation measures. The perception, in Hungary but also in the rest of the EU, that the maintenance of such charges will still do some contribution to the environment may be one of the relevant factors explaining its political acceptability.

What role for environmental vs. developmental objectives?

Although the recovery, preservation and effective protection of water resources are aimed at playing an increasing role in water policy, real-world EPIs are better characterized by a mix of both: the conventional (developmental) and the still emerging (environmental sustainability) objectives.

The former tends to consider water management as an instrument of development policy. In accordance such perception water policy goals are subordinated to development objectives to which water management is expected to contribute to (such as energy development, as in CS#15, CS#17 or CS#18, all of them on hydropower in Switzerland or Germany, and the Po Basin in Italy; irrigation expansion, as in the water markets assessed in CS#22-Colorado, CS#23-Murray Darling and CS#30-Chile; tourism services, as in CS#26 or CS#19; and land settlement, as in some of the above-mentioned non-EU studies on water allocation mechanisms).

The real difference lies in whether the EPI has resulted in more water to be used in the economy (a legitimate economic development objective) or rather in more water available for environmental purposes (which can reduce scarcity and drought vulnerabilities in the future: a sustainable development objective).

Otherwise, the modern perception of water management upgrades the importance of water policy and is focused on coordinating and accommodating all these sectoral policies into a collective strategy aimed at making sustainable the use and conservation of the available resources.

This distinction is still essential to understand the environmental outcomes intended and actually delivered by any particular EPI. This is clear in two of the case studies for the promotion of hydropower in Europe (CS#15 and CS#18), where the EPIs largely rely on subsidies that are expected to deliver a better environmental status without jeopardizing the hydropower sector performance. In spite of pursuing the same goal, the design of each one of these EPIs widely differs, and so does the outcome delivered. In Germany and Switzerland (CS#15 and CS#18) environmental outcomes depend on the EPI's performance while in the Italian case study (CS#17) it hangs on the performance of other command-and-control alternatives (and the EPI's aim is to foster investment in hydropower generation). The first two examples are closer to modern water policy while the third still gives priority to economic development objectives.

Following the same line of argument, subsidies for drinking water conservation in Cyprus (CS#20) are concerned with solving a drinking water supply problem with minimal financial costs, rather than with the restoration or conservation of water resources. Policy communication is also a concern and, in this case, the appropriate meaning of the self-declared goal ("making the provision of water services sustainable") does actually refer to solving the financial challenges of the water utility rather than environmental challenges of the Cypriot economy. The same happens with subsidies to promote the use of recycled water in southern Spain (CS#10), which have increased the amount of available resources but have not showed any improvement in the status of freshwater sources.

A number of EPIs have proven the potential of pricing schemes, markets and voluntary cooperation to promote economic development in many areas, but there is still room for improvement to enhance the effective contribution of EPIs to protect the environment and to manage water resources in a sustainable way.

Where does the right balance between financial and environmental objectives lie on?

Existing EPIs make evident that, rather than environmental concerns, the potential for revenue raising needs to be recognized as an (if not the most) important motivation to include prices in the water policy mix.

To assess past experiences and also to design workable EPIs it becomes crucial to distinguish between financial objectives (such as cost-recovery and revenue collection), on one side, and economic objectives (inducing socially desirable behavioural changes in order to improve efficiency and sustainability of water use), on the other.

As above, the distinction is not always clear, as most instruments are a combination of financial and economic instruments, but some examples in the extreme may help clarify not only the distinction but also its practical significance. For example, a water-trading scheme is a pure economic instrument (as it changes behaviour in a presumably efficient way), but does not help to fund the public budget. On the contrary, a flat-rate tariff for water is a pure financial instrument (as it collects money) but does not change current water demand. Moreover, public auctions of water use rights and volumetric tariffs are a blend of both financial and economic instruments. The distinction is of utmost importance for obvious reasons: financial instruments that leave behaviour unchanged cannot deliver any environmental outcome and, although they may contribute to make the provision of water and sanitation financially viable, they do not necessarily result in a real contribution to make water resources management more efficient and really sustainable[6].

In addition, the conditions for an effective price instrument are precisely the opposite of those for a revenue raising tax: the purpose of a price instrument is to change behaviour and thus it should be an ineffective means of raising revenue. Conversely, the objective of a revenue raising tax is to maximise revenue and this requires that the effect of the tax on behaviour is minimal.

Some case studies show interesting trends aiming at transforming financial instruments into real incentives to change water users behaviour. The practical question may be formulated as follows: given a possible choice between changing behaviour and raising revenue, what is the policy preferred option? The answer to this question has also been changing over time. Traditionally, financial instruments were clearly the favoured ones: flat-rate tariffs for water (on a head count or surface basis) were considered as appropriate since they did not require special monitoring equipment.

Precisely because flat rates do not discourage water demand, they are associated with a more stable flow of revenues, which makes them suitable as a reliable cost-recovery mechanism. Irrigation prices in Southern Europe and household water

[6] For the very same reason that pure economic instruments might not be financially sustainable in the long term.

tariffs (CS#8-10 in Spain, CS#16 in Italy, CS#20 in Cyprus) in England and Wales (CS#12) still follow this pattern.

Yet, flat rates may not be efficient (as they may foster squandering), neither fair (as income levels or actual water use may not be taken into account to set prices), but they have been socially acceptable as far as water was not scarce and its costs were not too high as compared to household budget or business turnover.

Yet, things can rapidly change when water becomes scarce and unpredictable or as a result of the implementation cost of more stringent environmental standards. In other words, water scarcity and social preferences may be important drivers in the transition from financial to economic (and environmentally relevant) policy instruments (as stated in CS#1 in Tagus River, Spain).

At least three EPI-Water case studies show, for example, how increased scarcity and higher marginal provision costs can bring to surface the inefficiency of flat rates. If water expenditure becomes relevant in household and farm budgets, responsible users may have the incentive to highlight it through, for example, the installation of a metering device or by accepting to pay a higher unit price in exchange of being charged for its real consumption rather than by the average consumption of all water users. Hence, driven by equity concerns and by individual incentives, the previous financial instrument cannot only become fairer, but also a real EPI with the ability to reduce water demand and improve its allocation in the economy. This story can be illustrated by case studies on water tariffs for irrigation in Emilia Romagna (CS#7), the move towards water metering in England and Wales (CS#12) and the progress towards a water budget rate structure increasingly applied by water utilities in California (CS#27) or even Israel (CS#24).

Why not using one instrument for each purpose?

As above, financial and economic objectives of water policy are clearly different to each other? If aware of the difference, one would not fall in the common mistake of ascribing the effective outcome delivered by one instrument to another one.

For example, since the Council Directive 91/271/EEC of 21 May 1991 concerning urban wastewater treatment was passed, Member states have the obligation to control wastewater and to treat point effluents. The environmental outcome delivered is then attributable to the installation of these plants and not to the cost recovery mechanisms chosen by each country to guarantee the operation and the renewal of these plants (most of them, especially in Southern Europe, built with Cohesion and Structural funds not recovered by prevailing effluent charges).

It seems irrelevant, though, whether fees, taxes or other financial instrument are in place since the building and operation of treatment plants is not a voluntary decision (thus, it does not depend on any specific financial instrument).

Should effluent charges have any environmental outcome, one would need to search for it in its effect over the demand for water services. As a matter of fact, because of stringent environmental standards as a result of European Directives and financial instruments implemented to support them, this is the main reason why water prices have increased all across Europe (i.e. someone needed to pay for the required upgrade in WWTPs, monitoring schemes, etc.). Paradoxically, an alleged quality instrument is demonstrated to have actually been the most powerful quantity instrument (for example, more than 90% of price increases and of the associated water demand reductions in Spain are due to the internalization of new wastewater treatment costs)[7].

If financial and environmental objectives are different to each other the more reasonable policy option is a mix of two instruments, each one conceived to serve one of both purposes[8]. EPI-Water provides an example of this kind of innovative instruments; in this case, an operational mix of financial and economic incentives. The former is intended for funding the real objective of the instrument mix; the latter to induce changes in behaviour in order to promote the environmental objective of water policy. A financial instrument (a water tariff) is intended to collect the money required to induce the improvement in water quality (through a set of subsidies to foster given practices).

It is the case of the water abstraction charge combined with compensation payments in Baden-Württemberg (see CS#13)[9]. In this case, the genuine environmental outcome to be assessed was that of the good farming practices inducing subsidies while that associated with water pricing (the supporting financial policy instrument) is of course very relevant but for a different reason: as a support to make the whole policy acceptable and financially feasible.

From prescription to actual choice: the critical importance of a sound design of the EPI

The real difference between command and control and EPIs, as alternative or complementary instruments for water policy, is that the latter relies on chosen rather than on legally prescribed individual decisions. Hence, the main purpose of any EPI must consist in adapting the diverse individual decisions of households, firms and

7 Although operation and maintenance cost recovery levels differ from place to place those investment costs covered by cohesion funds have not been recovered at all (as they are actually allowed by the Spanish law: legally that would be the equivalent to a double levy for the same service – one to the EU and the other to water users – of the same costs; Villar y Maestu, 2007).

8 In the previous example there is also a policy mix of one instrument to improve water quality (the compulsory setting of wastewater treatment capacities) and another for cost recovery (a kind of effluent charge).

9 This is a good example of the "one instrument for each purpose" golden rule recommended for the optimal design of incentive schemes. In this case, the desired behaviour is furthered by subsidies and financing is pursued through water prices. It would a real mistake to understand the water price as a kind of a quantity instrument (which would not make any sense in a water-abundant country like Germany: water prices in excess for water provision costs are not exclusive to water scarce countries).

farms (driven by their own knowledge, budgets, tastes and, basically, by their individual interests) to the courses of action that may be considered as the most appropriate from a social or collective welfare perspective. Water authorities, presumably representing the common interest and other stakeholders have the ability to decide on the rules of the game and then to direct decisions of all the individual agents.

Any incentive scheme has two essential requirements to be a practical one.

The first one consists in widening the array of decisions available for each water user involved (i.e. buy different amounts of water, sell and buy water use rights, deliver a higher or lower effort to prevent water degradation, etc.), which are attractive enough so that agents are interested in taking part in the game (in the abundant mechanism-design literature this is called the participation or the rationality condition; see Börgers, 2010)[10].

The second condition, and the really important one, is that the action chosen by the agents must result in a real contribution to the policy goals (e.g. the efficient and sustainable use of water); this is the so-called incentive compatibility condition. Experience shows that many poorly designed EPIs might comply with the first but not the second condition.

In dry areas where close sources have been already exhausted anyone is glad enough in accepting non-conventional recycled or desalinated water for free nor even with a subsidy (so that the participation condition of the incentive scheme is fulfilled). This is not necessarily a step forward towards reducing water scarcity or to recover freshwater sources (and the incentive compatibility condition fails). See, for example, CS#9 and CS#10 in Spain. Along this line, experience shows that firms might have rather obvious incentives to voluntarily accept the installation of water saving devices specially if they are financed by the water authority (participation), but it does not automatically lead to lower water consumption as the water saved can be used for more water-intensive crops or to increase the irrigated area (as in the case of many subsidized programs to modernize the irrigation infrastructure in Spain or in Chile).

The ecologically friendly electricity programme in Germany (CS#18) provides incentives for energy companies to install costly infrastructure (e.g. fishing passability), especially as that is compensated by a 20-year flow of guaranteed revenues. However, their proper maintenance and operation is not ensured (as current behaviour is not monitored and the only enforcement criteria is the installation of the infrastructure).

Likewise, water trading is supposed to be a means to increase the overall allocation of water amongst places and economic activities. Provided transaction costs are not

[10] The participation condition means that people must, for example, buy water, accept a subsidy and be willing to engage in water trade. But also that people prefer the alternatives proposed by the EPI rather than maintain the status quo. All that means that water users have something to gain by participating in the game proposed by the EPI.

exorbitant[11], the participation condition is more likely fulfilled when there are important differences in the marginal value of water giving place among potential buyers and sellers and mutually beneficial agreements are feasible (so that the participation condition is met)[12].

Nevertheless, in many water right trading schemes, incentive compatibility is not guaranteed. Representative examples show that the option to trade water may put into use a substantial amount of resources that in the absence of trading opportunities would have remain in Nature. In this case, water markets can paradoxically contribute to increased water scarcity and to spread water scarcity along the territory. This is already shown in the water transfers in the Middle Tagus in Spain (and it is even more evident in the Henares irrigation district as shown in CS#1), but it has also been proven, at a much higher scale, in the Murray Darling basin in Australia (CS#23).

Are there ways to compare intended and observed environmental outcomes and reach a robust conclusion on the benefits of any EPI?

Many water-policy EPIs and command-and-control instruments are implemented and advocated on the basis of presumed rather than real outcomes. As proven in this research, the environmental effectiveness of even the most popular and better-accepted examples is subject to serious shortcomings.

In many cases, even when the desired outcomes were observed, changes are hard to link to the EPI in place. Water demand has been severely reduced indeed in Hungary but the best candidates to explain such a trend are, first, the economic downturn and, second, the more stringent water regulations implemented for Hungary's accession to the European Union. Water resource and load fees only played a marginal role (CS#5 and CS#6).

In a different context, how much of the recent expansion of hydropower in Italy is a response to a combination of peaking oil and coal prices and the implementation of the Kyoto protocol and how much to the substantial subsidies paid for renewable energy? The environmental outcome delivered is in the answer to this tricky question (CS#17).

Even when EPIs apparently fail, things might have been worse in its absence: without the Danish pesticide tax (CS#4) diffuse pollution would have been worse[13].

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[11] Both the Chilean (CS#30) and Australian (CS#23) markets have a similar system of pro-rata share of water stocks, intended to reduce transaction costs and to eliminate opposition to transfers.

[12] In all case studies on water markets, one may have expected major differences in water prices across uses and that these differences might persist beyond what can be explained by asymmetries in conveyance costs and water quality, suggesting that water markets may have not developed fully enough to optimize efficiency gains. Yet, the comparison of case studies #22, #23 and #30 is not straightforward.

[13] This could have also been the case with the Dutch groundwater tax (CS#11). Groundwater depletion and degradation is a long lasting challenge in The Netherlands water policy. Despite partial flaws, as

The failure to reduce the Water Treatment Index only shows that the pesticide tax was only able to partially compensate for the powerful incentives to extend agricultural surfaces and yields resulting from high commodity prices. Additional difficulties can be found in CS#19, where a particular geological configuration generates a 20-year lag between implemented actions and the assessment of environmental outcomes.

In addition to that, EPIs are applied in combination with other instruments and the observed outcome is the result of a policy mix. Design analysis tends to fall in the embedding mistake when considering that all the benefits of improving ecological status can be attributed to the EPI (CS#7, CS#8 and CS#9), which may be as fallacious as considering the EPI's outcome as irrelevant. A better option consists in recognizing the individual changes in behaviour that were induced by the EPI, and the associated changes in pressures and environmental impacts.

In that case there would also be some scope for contradictory results: some initiatives may be failing because of the success rather than the flaw of the overall water policy. The voluntary agreement to restore the river regime in the lower Ebro is currently being revised once the effectiveness of controlled floods to remove the invasive algae (and other microorganisms) disturbing the operation of power plants is lower than only ten years ago (CS#2). As a result of that, the power company is now less interested than before in the agreement. A plausible reason might be the rapid improvement experienced by water quality as a result of the installation of sewers and water treatment plans all along the river (despite flowing water being still low, macrophytes can now grow stronger).

In many cases, changes in behaviour guarantee the reduction of water pressures. The case is more evident when these pressures are directly observed as in the certification of hydropower plants or the observed water quality before and after the installation of a water treatment plant. Water fees (see CS#14) have effectively serve as a financial instrument to fund the capital operation and maintenance of water treatment plants but have also acted as an economic instrument given its potential to increase water prices and to reduce water demand (and water loads). The same situation can be found in most EU countries as a result of the implementation of the urban wastewater treatment Directive (91/271/EEC) and progress in cost recovery.

Another important advantage over command and control relies on its capacity to manage social conflicts[14] while opening the option for mutually beneficial agreements amongst stakeholders (such as in CS#2, CS#3, or CS#21).

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assessed in CS#11, it gives the impression, though, that without the tax things may have been even worse.

[14] In CS#21, offsetting to solve salinity problems in Australia is assessed as a cost-effective alternative in comparison to the conventional regulatory approaches (i.e. standards), as it allows environmental improvements to be achieved at a seemingly significant cost reduction.

4. Are EPIs suitable instruments to cope with current water policy challenges?

Above all, the real question is whether EPIs, when properly designed and implemented, can make a real contribution to improve water policy decisions. In particular, to what extent they are able to cope with the real challenges of water governance. Some of them are of a global scale, like coping with climate change and the severe water uncertainty linked to it; others are just local (site-specific), such as the degradation of water sources nearby. Given the variety in the nature and scale of water challenges, the still preliminary answer to how EPIs can contribute to their solution is organised in three particular categories: preventing the degradation of water quality, tackling increasing water scarcity and improving impoverished river ecosystems. Some categories for which there are not still EPIs in place, such as global warming, and some others, for which no particular EPI was considered within EPI-Water's choice (such as flood and drought risk), are not discussed.

What is the potential of EPIs to reverse the degrading trends in water quality?

Overview

The chemical quality of water in surface and groundwater sources depends on both, the natural conditions of the river basin and the pressures exerted by humans and their economic activity. In an integrated river basin framework one needs to recognize that the measures able to improve that quality are not only those *end-of-pipe* alternatives designed to reduce pollution loads. Measures primarily designed to save water and to reduce abstractions have a real effect over water quality as they facilitate dilution, oxygenation and transport of pollution loads. Similarly, water quality is also the result of the self-treatment potential (i.e. natural assimilation capacity) of water bodies. There are obvious links between quantity, quality and system restoration measures that ought to be considered in an integrated approach.

- Nevertheless, for the purpose of extracting some broad lessons from case studies considered in EPI-Water, the potential of improving water quality by managing point and non-point pollution sources will be discussed. Each one of them poses a distinct challenge for water policy: *point-source pollution* is a single and identifiable kind of harmful activities that need to be controlled by focused regulations and precisely defined licenses concerning the volume and content of the effluents discharged into the water environment. Individual decisions with respect to environmental outcomes are only possible once certain safe minimum standards are in place. Pricing schemes are almost exclusive to countries which have already implemented water policies and markets over water point pollution loads are not an option as significant scale economies of wastewater collectors and treatment plants convert them into a natural monopoly without a possible choice for households and other water users. Not surprisingly, normative prescriptions play the dominant role. These ideas are not in contradiction with the existence of instruments such as load fees (in Hungary, CS#6), point pollution charges (paid in exchange of a water disposal service provided by a public utility, as in CS#8 in Spain), effluent taxes (in Germany, CS#14) and trading mechanisms (CS#25 in Ohio, USA).

- On the other hand, *diffuse pollution* represents a particular challenge for water policy. The main reason is that the resulting quality of concerned surface and groundwater bodies is the consequence of many individual actions scattered throughout different places. In addition, decisions in a particular place might affect distant water bodies in a way that is not completely understood by available land use and impact assessment models and tools. Individual actions are in general unobservable and in practice it is almost impossible to determine how much any farmer or other water user contributed to the observed degradation in a water body. This is why tariffs (as in the Danish Pesticide Tax, CS#4) or use rights, for example, cannot possibly be defined on the effective contribution to nitrate concentration in a river stream. EPIs, when feasible, are mostly addressed to change behaviour patterns which are far from but meant to be closely linked to actual pressures exerted by water users over the environment (as in CS#26, CS#19, CS#13 and CS#3). The case of salinity offsets in Australia (CS#21) can be considered in a different group.

Lessons learnt from the case studies

Point-source pollution case studies

CS #	Name of EPI
6	Water Load Fee in Hungary
8	Pollution Charge in Serpis River
14	Effluent Tax in Germany
25	Water Quality Trading in Ohio
29	Nitrogen Reduction in North Carolina

EPIs aimed at reducing *point source pollution* must be understood in the context of water policy development in each country. In Hungary (CS#6), effluent loads basically respond to the adaptation of environmental standards required in the accession process to the EU. The water load fee, implemented in 2004, may have played a relevant role in reducing water demand after it was transferred to consumers in higher water tariffs, and also indirectly it might have reduced pollution loads. Even the financial contribution to water policy of this instrument is disputable as proceedings make part of general public budget, and the improvement in water quality is a proven outcome of the installation of wastewater treatment plants mostly funded by EU cohesion funds.

In the Serpis river basin (CS#8) and overall in Spain, wastewater charges have been introduced as a cost-recovery mechanism along with the implementation of the Council Directive 91/271/EEC concerning urban wastewater treatment. The technical requirements, the volume and the composition of effluents permitted for any place, depending on the status of receiving water sources, were already defined. Little scope, if any, was left to individual decisions. Both the contribution of these prices to improve the ecological status of water bodies and to the success of water management plans to implement the WFD (some of them still to be approved) are uncertain. In Spain (and also in Hungary), water pollution is priced by volume and according to the effluent allowances are granted to each wastewater plant, there is no way to reward (through lower charges or fees) improvements in the quality of the effluent beyond what is legally prescribed. In both cases the instrument might have contributed to increase water prices and to reduce water demand (paradoxically performing better as a quantity rather than a quality instrument), and concerning water quality they may become an important element for the financial sustainability of sanitation services provided by water utilities in both countries.

In a similar way the German effluent tax (CS#14) is one piece of a policy mix, which also consists of discharge permits, pollution limits and mandatory technological standards. The policy mix, as in the previous two examples, has been mostly successful in obtaining its objectives but the real contribution of the effluent tax is impossible to single out. The tax is also based on permitted effluents both in volume and composition in such a way that incentives for further pollution reduction without technological change are missing. However, at least three complementary instruments may have played a significant role in reducing pollution and increasing the dependability of water quality targets. First, monitoring systems help verify that pollution limits are not surpassed and to set non-compliance fines that provide an incentive to stay within limit values. Second, along the implementation process three-quarters of private enterprises and two-thirds of municipalities had increased, accelerated, or modified their abatement measures for water pollution in anticipation of the charge. Finally, although the role of the effluent charge to reduce pollution substantially faded once the prescribed limits were obtained, firms still have the option to prove they are below these limits and are subsequently eligible for a tax rebate. The incentive has worked better for private than public utilities.

A trading mechanism is only feasible in exceptional circumstances for point pollution. The basic requirement consists in having many pollution sources within a common water body, so that a unit of pollution in one point can be exchanged for a given amount of pollution in another. As shown in the water quality trading (WQT) programme in Ohio (CS#25), this exceptional trading schemes may be of use to share water treatment burdens amongst the different sources reducing compliance costs whilst guaranteeing desired pollution limits. Trading can also facilitate a smooth transition to more stringent pollution limits. The pilot scheme allows for improving the design of the instrument and further results are expected to assess the transferability of these results.

Diffuse pollution case studies

CS #	Name of EPI
3	Cooperative agreements between water supply companies and farmers in Dorset
4	The Danish Pesticide Tax
13	Water Abstraction Charges and Compensation Payments in Baden-Württemberg
19	Financial compensation for environmental services: the case of Evian Natural Mineral
21	Salinity offsets in Australia
26	New York City watershed agricultural program

The main problem of *diffuse pollution* is that it is almost impossible to ascertain how much any farmer or other user contributed to the observed degradation in a water body. The consequence is that tariffs are regarded as an appropriate EPI, as in the Pesticide Tax in Denmark (CS#4). This tax does not distinguish among locations and is homogeneous for the whole area of reference. The effectiveness of the tax is assessed according to the Treatment Frequency Index (TFI), a simple but limited indicator that measures the quotient between the fertilizer applied and the amount required by existing crops at a national level. The TFI shows that water policy has clearly failed to deliver the intended outcome of stabilizing the TFI at 1.7, but things may have been worse in the absence of the effluent tax (the highest pesticide tax in Europe). In such a context it is impossible to know whether the reason for this failure is the low price-elasticity of fertilizer demand or that despite being elastic its positive effect has been compensated by scaling commodity prices, high biofuel demand or any other factor explaining agricultural growth or other. Even if a TFI lower than 1.7 had been reached, this could not have been interpreted as any successful indicator at all. It is only an average indicator (compatible with water bodies in poor conditions) and it is still not clear what effective environmental outcome a 1.7 TFI would deliver. The main lesson is that tackling diffuse pollution by taxing proxies for pollution and using far but practical indicators to assess its success is associated with high uncertainties about its effectiveness.

An alternative lies in approaching diffuse pollution from the perspective of managing land and water ecosystems as economic assets and finding the way to reconcile the diverging pressures exerted by their users. Rather than taxing the use of an observable input with unobservable consequences over the environment, this alternative is about adapting the observable practices of water users in order to maintain or protect a desired status of a river basin. Improvements in the status of water bodies are economically feasible as far as the willingness to pay of potential beneficiaries of such improvements is higher than the compensation required for those in charge of delivering them. Four EPI-Water *ex-post* case studies follow this logic: CS#3, CS#13, CS#19 and CS#26.

In the Dorset case study (CS#3), 52 out of 74 farms made voluntary cooperative agreements (with an initial economic compensation) with the regional water utility regarding implementation of measures to abate nutrient pollution, reducing water drinking provision costs and increasing water security. In Baden-Württemberg (CS#13), compensatory payments are financed with water abstraction charges. In the Evian case (CS#19) the private company helps farmers complying with standards and adopting sustainable practices. Additionally, The New York City Watershed Agricultural Program (WAP) (CS#26) has been able to define individual Whole Farm Plans (WFP) of 416 farms and to find the financial agreements to guarantee their adoption.

A number of logical arguments make the environmental outcomes delivered by these alternatives disputable. Effectiveness is still to be proven in Dorset, alternative explanations do exist for reduced pollution in Baden-Württemberg, command-and-control constraints might have played a dominant role in ensuring the quality of the protected Evian ranges, and there is not a plausible counterfactual to demonstrate that the reduction on the phosphorus pollution experience in New York could not have been obtained anyway. Nonetheless, these are all success stories and, in spite of the lack of robust empirical evidence, it is more likely that reasons rest in some important advantages over alternative EPIs (as the above-mentioned product tax) and command-and-control instruments.

EPIs can help enhancing the economic value of on-site environmental services provided by water resources. For example, in Dorset, adoption of good practices has cleaned out peak pollution events. Likewise, individual farmers do not have the skills or financial resources to identify best practices (especially when they depend on local circumstances – like soil types, moisture content or other agronomic factors) and the collaborative scheme can reduce information costs facilitating the coordination (as in CS#26, CS#19, and CS#3). All this might not have a discernible impact in the short term but definitively it is a step forward to reduce uncertainty over the long-term status of conservation of water bodies (degradation risks have been severely reduced in the cases considered).

Even if the environmental status remains stable, the transition in farm production allows for a higher welfare level making the financial compensation redundant (in CS#3 the collaborative scheme proceeded after farmers stopped receiving side payments). In Evian, Dorset and the Cat-Del basin in New York cooperation is a means to empower local users with the conservation of a natural and economic asset, which outsiders depend on but, thanks to the cooperative agreement, that is also critical to the sustainability of their economic activities. All these reasons are difficult to experimentally link with data but are powerful arguments, however, in favour of long-term positive environmental effects and contribute to reduce uncertainty over the conservation of natural assets.

Finally, a special mention needs to be made to salinity offsets in Australia (CS#21), where reducing salinity in different points can compensate for excess in salinity in one point. Although the scheme allows to maintain and eventually reduce salinity overall, command and control is still required to locally monitor excess salinity. The EPI is intended to provide water users with an alternative to adapt decisions to increased salt loads and more stringent regulations and has also served to finance restoration projects with the potential to reduce salinity loads. In short, salinity rate threats in Australia have been abated over the period, and various salinity mitigation initiatives, including offsets, may probably claim at least some credit for it.

What is the potential contribution of EPIs to cope with increasing water scarcity?

Overview

Managing water quantity means coping with the challenge of combining welfare increases and the production of those goods and services provided by the economy with the limited ability of water ecosystems to provide those activities with a continuous and dependable amount of required water.

The true question in this respect seems to be whether EPIs can make a real contribution to deal with excess demand of water services (water scarcity) and with the uncertainty in water provision (drought risk). The strategy adopted to handle these demanding tasks includes one (or a combination) of the following intermediate targets to which EPIs are expected to make a significant contribution:

- Improving water resource allocation everywhere and among economic uses in order to increase the potential of the economy to improve the provision of goods and services within the limits of available water resources (such as in water markets in Chile, Australia and Colorado (USA), assessed in CS#30, CS#21 and CS#22, respectively).
- Making water allocation to alternative uses contingent to available resources every time in order to reduce welfare losses and provide a better response to droughts (CS#1 in Spain).
- Increasing the technical efficiency in the production of water services so that they can be obtained with lower withdrawal rates from freshwater sources (by improving irrigation techniques, reducing leakages in water distribution networks, etc.). This can be the result of EPIs especially aimed at this goal (as in CS#24 in Israel and CS#16 in Italy) or an indirect effect of other EPIs (CS#12 in UK, CS#25 in Miami (Ohio), USA, CS#26 in New York, USA and CS#27 in California, USA).
- Replacing water provided by the natural environment by alternative resources intensive in human-made capital or non-conventional water sources such as reused or desalinated water (CS#10 in Spain).

- Reducing water demand from households, agriculture and manufacturing. This is the case of the water resource fee in Hungary, Netherlands and China (CS#5, CS#11 and CS#28), water metering in Italy and the UK (CS#7 and CS#12), the tailoring of rate structures in California (USA) (CS#27) and water taxes in Italy (CS#16).
- Some additional instruments are mainly aimed at subsidizing desired behaviour, such as the subsidies for drinking water conservation (CS#20 in Cyprus) and the incentives to promote the use of recycled water (CS#10 in Spain).

Normative instruments have traditionally pursued these intermediate objectives of water policy but, as EPI-Water WP3 case studies make clear, incentives are playing an emerging role.

Lessons learnt from the case studies

CS#	Name of EPI
1	Water transfers in the Tagus River Basin (Spain)
5	Water Resource Fee in Hungary
7	Water tariffs in agriculture in Emilia-Romagna (Italy)
9	Voluntary intersectoral water transfer at Llobregat River Basin (Spain)
10	Negotiation and monetary incentives to promote the use of reclaimed water at the Tordera River Basin (Spain)
11	Groundwater tax in the Netherlands
12	Water metering in England and Wales
13	Water abstraction charges and compensation payments in Baden-Württemberg (Germany)
16	Water tariff system in Italy and tariff structure in the region of Emilia-Romagna (Italy)
20	Subsidies for drinking water conservation in Cyprus
22	The efficient water market of the Northern Colorado Water Conservancy District (USA)
23	The role of unbundling water rights in Australia's Southern connected Murray Darling Basin
24	Price setting of urban water under centralized management (Israel)
27	Water Budget Rate Structure (WBRS) in California
28	Case Study of China
30	The Chilean water allocation mechanism, established in its Water Code of 1981

Experience with water markets shows how important they have been in helping find mutually beneficial agreements between buyers and sellers, thus increasing the production of goods and services and making water trades a convenient instrument to promote agriculture, manufacturing, hydropower, and other economic activities. These development objectives were the main driver in the original adoption of current water trading schemes and concerns on their environmental outcomes (although not completely absent in origin) is still an emerging issue.

Evidence shows that trading schemes may have increased pressures over water resources (by putting into use water that might not have been used in the absence of markets). It is usual that in surface and groundwater systems where water entitlements and allocations are not tradable, a significant proportion of the entitlements under issue might not be used. Reasons for non-use include holding resources as a reserve to face drought events. This has been the case of the Murray Darling basin in Australia, where the emergence of a complex and profitable water market has resulted in over-allocation that threatened the fulfilment of environmental goals. In order to solve this problem a series of measures have been implemented, including command and control policies (first by a decision to secure 500 GL of water for the environment under a Living Murray Initiative and second by the transfer of Basin wide water planning responsibilities to an independent Murray Darling Basin Authority) and financial instruments (the commitment of A$3.1 billion for the purchase of water entitlements from irrigators and the commitment of A$5.8 billion for investment in so-called water saving projects). However, these policies may not be enough to face the challenge of increasing demand. In Chile, for instance, the whole river flows had been allocated since at least three decades, which has led to the deterioration of aquatic ecosystems in semiarid and arid regions of the country (with significant problems in the region of Copiapó, in northern Chile). This can be said to be gradually changing with a series of reforms implemented since then (such as forfeiture for non-use), but positive environmental outcomes are still to be proved.

On the other side, physical interactions between water bodies along a river basin (including instream uses and the connection between surface and groundwater definition of property rights that can be efficiently traded in a market is still a challenge) and externalities (and third-party effects) that may arise, still make it difficult to find a set of property rights that can be efficiently traded in existing water markets. For instance, in Chile increased consumptive water use market activity has generated increased conflicts with downstream users due the effects of water entitlements over return flows. Almost all consumptive water use right holders generate significant return flows (leakage and seepage water) that are used by downstream customary right holders, but it is not known how these customary use rights are dependent on return flows.

Voluntary trading can play a critical role in stabilizing the economy and in providing an effective drought management alternative, provided all stakeholders are involved and provisions are made to compensate for third-party effects. This was demonstrated in the Tagus river basin in Spain (CS#1), where the voluntary agreements allowed the optimization of existing water resources without building additional infrastructures, engaging in massive groundwater abstractions or significant political costs.

Water scarcity on its own is a driving factor to increase water efficiency. Scaling up marginal costs makes the reduction of leakages in urban distribution networks more profitable and better irrigation devices are more advantageous when they avoid paying for more expensive and less dependable amounts of water. EPIs can enhance these kinds of answers to water scarcity. This has been the case in Israel (CS#24), where water and sewage corporations now operate under a business-economic system that requires following a set of targets for a steady reduction in water losses.

Potential gains from increasing the technical efficiency of distribution networks is also evident in the Llobregat River Basin (CS#9, Spain) and, apart from water shortages and social awareness, the social ability to capture these benefits would have been even higher if EPIs were in place to foster this response to physical scarcity and increased water provision risk. Furthermore, water users affected by scaling provision costs and easier ways of identifying leakages are rather motivated to find alternative arrangements in order to protect the conservation of the water environment (CS#26 in New York, USA, CS#12 in the UK and CS#16 in Italy) and, when public utilities are paying for the environmental cost of the resources they use (as in CS#26, CS#25 and CS#27 in New York, Ohio and California, respectively), they are also more likely to invest in increasing the technical efficiency of their provisioning network (as the avoided costs and the potential benefits of such actions are higher).

Modern technologies do allow for substituting freshwater for alternative resources and, particularly, in places affected by severe water scarcity this substitution opens up the opportunity to the recovery of overexploited sources (CS#10 in Spain). Nevertheless, the actual implementation of such alternatives gives priority to increasing available resources rather than reducing pressures over the environment.

The scant experiences in Spain show that farmers are in general willing to accept alternative resources as buffer stocks to cope with droughts but, at the same time, are on the whole reluctant to give up freshwater use rights in exchange. Experience in this respect is still recent and the optimistic projections of environmental outcomes that motivated the design of such instruments in Spain are still to be confirmed by a robust *ex-post* environmental impact assessment. The evidence of important opportunities is an indicator of the scope for looking to specific and properly designed incentive schemes to promote the increasing production and use of alternative resources in order to cope with water scarcity in Spain.

Water demand management alternatives become more attractive when scarcity and more stringent environmental requirements increase the provision cost of water. In all these cases EPIs can be built upon the willingness of water users to adapt behaviour to the new circumstances. This is the case of households in England and

Wales (CS#12), which are willing to accept metering in order to be charged by their individual instead of by the average water use, and the same applies to the case of irrigators in Emilia Romagna (CS#7). It has been reported that water users that opt for water metering show water consumption levels significantly lower than average. However, it is difficult to say if this happens because of the EPI or just because people with meters opted for water meters exactly because they already used less water before meters had been installed. Overall, the impact of water meters on water scarcity and stressed environments is yet unknown; that said, consumption also falls when an "average" household is metered.

Water taxes are allegedly also a useful means to reduce water demand. In the region of Emilia Romagna (RER) in Italy (CS#16) a general decreasing trend can be noticed in water consumption and withdrawals after the implementation of water taxes, as well as a parallel improvement in household access to water supply and sanitation. However, there is a lack of sufficient and reliable data and further evidence is needed to confirm their actual effectiveness.

Abstraction fees have been also common, although their outcome has been by far less successful (see for instance CS#5 and CS#28). More innovative approaches for water demand reduction such as the rate structure tailoring in California (USA) (CS#27) have been applied. Although it is generally regarded as a success, its applicability is heavily burdened by information availability and monitoring costs.

Subsidies for drinking water conservation in Cyprus (CS#20) were implemented to cope with the challenge of adapting drinking water demand to the existing production capacity in the public utility, rather than with the ability of the environment to provide the required resources in the long term. Hence, the EPI is compatible with subsidizing the construction of boreholes where households can obtain mostly uncontrolled amounts of water for purposes other than drinking. The EPI may be a success in avoiding financially costly alternatives for drinking water in a water-stressed country, but it is certainly a questionable instrument for promoting the sustainable use of surface and groundwater. The same can be said, for example, of incentives to promote the use of recycled water (see CS#10).

What contribution can EPIs make to the restoration of river ecosystems?

Overview

The modification of river hydromorphology responds to the need of supplying society with a series of necessary inputs while reducing uncertainty in their provision. However, these goals may reduce the provision of environmental goods and services. The four case studies (CS#2, CS#15, CS#17, CS#18 in Spain, Switzerland, Italy and Germany, respectively) under assessment in this section try to combine both developmental and environmental objectives, although in a different way (methods and targets):

- There are EPIs that use voluntary agreements between parties at stake. These EPIs are useful to target a specific environmental problem and a specific change in operation to improve the environmental status of water bodies. This is the case of the voluntary agreement for river regime restoration services in Spain (CS#2).
- Other EPIs use subsidies and aim at a broader improvement of the environmental situation linked to hydropower plants, as in the case of the favourable electricity remuneration in Germany (CS#18) or the green labelling system in Switzerland (CS#15). These EPIs emphasize on the environment.
- Finally, there is scope for subsidies to invest in increasing hydropower capacity (CS#17 in Italy).

Voluntary agreements can play a relevant role in river restoration programmes, as long as cooperation is designed in such a way that all parts can derive benefits from it, including the hydropower operator, which follows common financial optimization rules. This implies that some of the environmental goals that may be addressed with alternative instruments (see below) can be left out to match the targets of the environmental policy to the financial objectives of private agents. For example in CS#2 in Spain, the implementation of a voluntary agreement between a private and a public agent has fulfilled the common public and private goal of macrophyte removal at a minimum cost. However, other environmental objectives that may be achieved through more comprehensive river restoration programmes are missed. The progressive drop of macrophytes removal rate may give a chance to a more ambitious agreement.

Subsidies for sustainable hydropower aim at improving local river conditions by setting the necessary incentives to develop environmentally friendlier hydropower generation. Although all these EPIs rely on compensation payments for greater environmental services, their design may differ greatly among countries. For example, in CS#18 the EPI aims at substantially improving (if not at reaching) the good ecological status of water bodies next to hydropower plants. This incentive scheme encourages companies to make investments to improve the ecological status of the river system; however, payments are not high enough as to provide adequate incentives for the ecological modernization of most of the small hydropower plants. In CS#15, though, the objective is the mitigation of broader hydropower impacts on Alpine landscapes. In this case, although there were significant environmental investments for improving the water status, no study identified yet how the actual status of the river has been enhanced. Furthermore, even though there has been a steady rise of the number of plants certified over the years, the level of certification is limited as only 3% of the hydropower plants are "naturemade" certified.

Also the design of the subsidy may vary. For example, in Switzerland (CS#15) the reward for adapting dams to the more demanding environmental goals consists in a green label which includes a supra-regional comparable certification and a fixed mark-up on every kilowatt-hour sold (that has to be reinvested on river restoration measures, though), while in Germany the subsidy comes through more favourable electricity tariffs.

Lessons learnt from the case studies

CS #	Name of EPI
2	Lower Ebro (Spain): Voluntary agreement for river regime restoration services
15	Green Hydropower in Switzerland
17	Green energy certificates and compliance market, Po basin, Italy
18	Subsidies for ecologically friendly hydro-power plants through favourable electricity remuneration in Germany

The impact of these EPIs on rivers remains unclear. In spite of the several measures and actions that have been taken to improve the water status in both case studies, there are no comprehensive studies indicating the overall change in the ecological status of the water bodies. However it can be concluded that, at least for the German case, there was an improvement of water bodies next to hydropower plants fulfilling environmental conditions, although again the magnitude cannot be exactly determined. This EPI defined payments of electricity generated by hydropower plants (feed-in tariffs) according to ecological criteria as set by the EEG, encouraging both the use of renewable energy sources and environmental preservation efforts.[15]

Subsidies whose objective is not targeting the mitigation of the negative environmental effects of hydropower use, but basically the extended use of the technology need to be considered along with command-and-control measures, which are of direct relevance to guarantee that these developments are compatible with the environmental protection of affected water bodies. A significant characteristic of the hydropower sector is given by the long concession periods granted to the companies.[16]. Such property rights entail that it is only when concessions need to be renewed that compliance with environmental regulation takes place. One declared aim of the EPI, both in the German and Swiss cases is hence to provide incentives for the compliance with these requirements much earlier, raising the question of the additionality of the effects of the EPI. At the same time, it stressed the importance of assessing the dynamics between a given EPI with regulation, not only in simple terms of additionality but also as to how they reinforce each other's implementation process,

The direct target may be concerned with other environmental issues than water (as in CS#17, reducing the country's carbon dioxide emissions and reduce dependency on

[15] The most significant criticism refers to the lacking possibility to control the actual ecological improvements on site.

[16] A dozen to 100 years, ore even unlimited entitlements.

energy imports). In the Po River (CS#17, Italy), which consists in a subsidy for new hydropower development, while the compliance to environmental standards is given to others (mostly command-and-control instruments); the whole scheme is supported by the pollution trading scheme implemented as part of the Kyoto protocol, although not the very instrument, but the policy mix it belongs to, can be considered a real contribution to the ecological status of improvement of water bodies as required by the WFD. Moreover, the quota system, by specifying a clear target for producing electricity from renewable sources, may result in heavy development of plants in particular regions and thereby having a negative impact on the environment, a component that was not included in the GECs. When the tradable GEC was introduced to encourage hydropower production it did not take into account the impact on the environment.

5. Conclusions

On the application of EPIs for water management

European Union case studies

- **Raising revenues: a means for a purpose.** Instruments primarily aiming at raising revenues with no direct change in water-related decisions are essentially financial instruments. Yet, as part of a policy mix, these instruments (i.e. revenue raising, cost recovery, etc.) can be critical complements of economic instruments (i.e. incentives). This is clear in CS#13, for instance: a water abstraction charge in a water-abundant country (Germany) is not really intended to reduce water use but rather to finance a program to induce better agricultural practices thus reducing diffuse pollution and improving the status of water bodies. Similarly, it is also the case of CS#5 (water resource fee in Hungary, whose resource fee initially raised revenue to an earmarked water fund, but gradually became a general flow for the public budget) and, to a lesser extent, of the Dutch groundwater tax (CS#11) in The Netherlands.
- **Water effluent levies: a challenging instance.** Some instruments are often designed to induce behavioural changes but happen to be ineffective to do so. This is, to some extent, the case of the different effluent levies considered (pollution tax in Germany, CS#14, groundwater tax in The Netherlands, CS#11, and load fee in Hungary, CS#6). Changing behaviour was one of the arguments to promote those taxes at some point in time (less important in The Netherlands, mentioned in passing in Germany and a key motivation in Hungary). Nevertheless, its importance as revenue collection and cost-recovery mechanisms were important as they served to move towards extending wastewater treatment and investing on improving water quality.

- **Information as a way to induce voluntary behavioural changes.** Other instruments are relevant to improve information for water management, to reduce monitoring, enforcement, and other transaction costs and can be important to enable the future implementation of EPIs within a policy mix. For example, in the UK (England and Wales, in CS#12), if the decision to install a meter is voluntary, this can actually be a real means to being entitled to a reduction in the water bill. Thus (but only in that case) this incentive (the reward of lower consumption) can then become an effective EPI with ancillary benefits in accelerating metering and preventing moral risk.
- **The contribution to WFD objectives should be (more) visible.** It is also common to find instruments mainly designed to promote a water-intensive economic activity (let us say hydropower or agriculture in water-stressed areas). To be an effective EPI, the promotion of hydropower in the Po Basin (CS#17) or Switzerland (CS#15) must be compatible with the protection of water sources and the guarantee that WFD objectives are met. Reallocating water and using regenerated water in Spain (CS#10) could be an operational EPI provided WFD objectives are taken into account.
- **Why did some instruments succeed and other failed?** Beyond other institutional variables, very often failure or success had to be with the delivery mechanism of the EPI. This mechanism is essential to assess the effectiveness of an EPI (since prices, taxes, bids, markets can be implemented in many ways). For instance, why may one think that effluent taxes are ineffective to reduce pollution? Is this because they are levied on presumed or licensed pollution loads rather than measured discharges? Is this because they are paid by utilities providing disposal services rather than by households who are responsible for pollution? Is this because they are calculated on the basis of the volume of water disposed rather than on its content? Or is it because the tax levy is too low to change an inelastic demand of discharge services?

'Inspiration beyond the EU' (IBE) case studies

- **The potential for water markets: non-EU remarkable experiences, underdeveloped option in the EU.** Water markets generally increase the efficiency of water allocation, although this admits countless nuances. They depend on the existence of marketable water rights, freedom to agree on prices, and information such as an adequate price-revealing mechanism (as it can be seen in case studies from the Murray-Darling Basin in Australia, Chile, and the Northern Colorado Water Conservancy District in the US: CS#23, CS#30, and CS#22, as well as in CS#1, in the Tagus River Basin, in Spain). The lack of these structural requirements prevents the formation of water markets (as in China, CS#28).
- **The structure of water use rights as a key variable to assess market performance.** In turn, the structure and features of water rights affect the

manner in which markets perform. Systems that limit marketable volumes to consumed water curb externalities and environmental threats (USA, Spain). Systems that allow the transfer of nominal entitlements without considering effective use face problems of overallocation and, most importantly, externalities (for example, CS#23: Australia, CS#30: Chile). In addition, Chile faced problems of water monopolization (in non-consumptive use rights). If streamlining and concentrating the approval process for transfers in a single body with adequate management powers (as in CS#22, US), transaction costs may be reduced. Limiting the parties to a transaction to agents already holding water rights and to uses ranking higher than the seller limit the performance of markets (not just in CS#1 but rather in Spain as a whole). The structure and performance of markets needs to be assessed and regulated as a process (CS#23: Australia) based on experience and trial and error (USA approach).

- **Water tariffs as signals for reduced consumption.** Water rates should be aimed at inducing changes in behaviour and not just at cost-recovery, even more in view of climate change scenarios, increasing vulnerability to scarcity and drought, and a sharp increase in the cost of bulk water. They perform better when part of the structure benefits from scale and scope economies, subjected to common rules and a common regulator (CS#24: Israel, CS#27: California, USA). Yet, they are affected by the external political environment, the municipality's self-interest, the need to address social issues (low income users) and incentives that convey mixed signals (as in Israel). The design of effective water budget rates requires strong social participation and consultations, and accurate data, i.e. well resourced water utilities, and public bodies able to collect and assess information (as in California).

- **Water pollution trading: requirements for operational instruments.** Trading of pollution permits requires the creation of pollution entitlements subject to property rights. They benefit from the existence of drivers inducing action at the local level, such as national legislation, definite pollution standards, and the possibility of external intervention, lacking local action (see CS#25 and CS#29, in Ohio and North Carolina, USA). The existence of a "champion" i.e. of a well-defined institutional focus promoting, overseeing and facilitating the activity is essential (CS#25). They require institutional cooperation and stakeholder participation (CS#25 and CS#29). There are examples of private-public negotiation wider than trading of pollution permits, such as the agreement concerning the Catskill-Delaware Watershed and the City of New York (CS#26), for watershed management to ensure improvements in water quality. The importance of external regulation and possible intervention was a relevant factor inducing the search for alternatives to waterworks i.e. paying for ecosystems services (PES). An institutional focus was created to manage and oversee a program with farmer's participation, for NYC to pay farmers for a management program for the benefit of the City. The program is successful and cost effective, but its replication elsewhere may be conditioned by the fact that the Catskill-Delaware watershed is a relatively underdeveloped area. Likewise, salinity offsets in Australia (CS#21) can also be seen as an example of burden sharing in the presence of economic incentives.

On EPIs and water policy challenges

Managing point source and diffuse pollution

- Regarding **point-source** pollution affecting water quality, normative prescriptions have traditionally played a dominant role and there seems to be a strong rationale for that. The combination of command-and-control instruments (i.e. emission standards), pricing schemes (i.e. taxes) and trading, seems to have the potential to improve water quality. Individual decisions with respect to environmental outcomes are only possible once certain safe minimum standards are in place. However, this is somewhat inconsistent with the existence of instruments such as load fees (CS#6), point pollution charges (CS#8) or effluent taxes (CS#14).
- In Spain (CS#8) and Germany (CS#14) water pollution is levied by volume and according to the effluent allowance granted to each wastewater plant; there is no way to reward (through lower charges or fees) improvements in the quality of the effluent beyond what is legally prescribed. In both cases the instrument might have contributed to increase water prices and to reduce water demand (paradoxically performing better as a quantity instrument), and concerning water quality they may become an important element for the financial sustainability of sanitation services.
- In the case of a good policy mix, as in the German effluent tax (CS#14), it is not easy at all to single out what the real contributions of the EPI are to the success in meeting targets.
- As to **diffuse pollution**, overall water quality levels in concerned water bodies are the result of many individuals all over the place. Hence, tariffs (CS#4) or use rights, for example, cannot be defined on the basis of an effective contribution to nitrate concentration in a river stream; on the other hand, taxes do not distinguish among locations and are homogeneous for the whole area of reference. Tackling diffuse pollution by taxing proxies for pollution and using but practical indicators to assess its success is associated with high uncertainties about its effectiveness, as in the Pesticide Tax in Denmark (CS#4), currently subject to reform.
- An alternative approach to diffuse pollution is through land management and water ecosystems as economic assets and adapting the observable practices of water users in order to maintain or protect a desired status of a river watershed. Improvements in the status of water bodies are economically

feasible as far as the willingness to pay of potential beneficiaries of such improvements is higher than the compensation required for those in charge of delivering them (CS#3, CS#13, CS#19 and CS#26).

- It all suggests that where the cost of abating pollution widely differs among scattered sources, an EPI-based system may have greater gains, relative to command-and-control regulations. Where abatement costs are more uniform across sources, the political costs of enacting an allowance trading approach, such as those in Ohio and North Carolina (US) may be less likely to be justifiable. The efficiency of price-based systems (i.e. effluent taxes or charges, etc.), as in the above-mentioned EU case studies, compared to quantity-based (trading) systems, such as those illustrated by non-EU case studies, depends on the pattern of costs and benefits.

Tackling scarcity and drought

- Experience with water markets shows their significant role in finding mutually beneficial agreements between buyers and sellers, thus increasing the production of goods and services and making water trades a convenient instrument to promote different economic activities. These development objectives were the main driver in the original adoption of current water trading schemes and concerns on their environmental outcomes is still an emerging issue.
- Evidence shows that trading schemes may have increased pressures over water resources (by putting into use water that might not have been used in the absence of markets). This has been the case of the Murray Darling basin in Australia (CS#23) and Chile (CS#30), where available resources are said to be over-allocated (although there is no empirical evidence on this for Chile, where this statement would accept a number of non-minor nuances). On the other side, physical interactions between water bodies along a river basin and externalities that may arise still make it difficult to find a set of property rights that can be efficiently traded. For instance, in Chile increased activity in consumptive water use markets has generated increased conflicts with downstream users due the effects of water use rights over return flows.
- Voluntary trading can play a critical role in stabilizing the economy and in providing an effective drought management alternative, provided all stakeholders are involved and provisions are made to compensate for third-party effects (CS#1).
- Water scarcity on its own is a driving factor to increase water efficiency. Scaling up marginal costs makes the reduction of leakages in urban distribution networks more profitable and better irrigation devices are more advantageous when they avoid paying for more expensive and less dependable amounts of water (CS#24).

- Modern technologies allow replacing freshwater for alternative sources opening up the opportunity to recover overexploited sources. However, it gives priority to increasing available resources rather than reducing pressures over the environment (CS#10). Experiences in Spain show that farmers are willing to accept alternative resources as buffer stocks to cope with droughts but reluctant to give up freshwater use rights in exchange.
- Water demand management alternatives become more attractive when scarcity and more stringent environmental requirements increase the provision cost of water. In all these cases EPIs can be built upon the willingness of water users to adapt behaviour to the new circumstances (CS#12, CS#7). It is difficult to say if lower consumption levels happen because of the EPI or just because people with meters already used less water before meters had been installed.
- Water taxes are also useful to reduce water demand (CS#16), as well as a parallel improvement in household access to water supply and sanitation. However, there is a lack of sufficient and reliable data and further evidence is needed to confirm their actual effectiveness.
- Abstraction fees have also been common, although their outcome has been by far less successful (CS#5 and CS#28). More innovative approaches for water demand reduction such as the rate structure tailoring in California (USA) (CS#27) have been applied. Although it is generally regarded as a success, its applicability is heavily burdened by information availability and monitoring costs.
- Subsidies for drinking water conservation (CS#20) were implemented to adapt drinking water demand to production capacity, rather than with the ability of the environment to provide the required resources in the long term. The EPI is compatible with subsidizing the construction of boreholes, which may be a success in avoiding financially costly alternatives for drinking water in a water-stressed country, but it is certainly a disputed instrument for promoting the sustainable use of surface and groundwater. The same can be said, for example, of incentives to promote the use of recycled water (see CS#10).

Restoring river ecosystems

- There are EPIs that use voluntary agreements between parties at stake that can play a relevant role in river restoration programmes (to target specific environmental problems and specific changes in operation to improve environmental status of water bodies), as long as cooperation is designed in such a way that all parts can derive mutual benefits from it (CS#2).
- Other EPIs use subsidies and aim at improving local river conditions by setting the necessary incentives to develop environmentally friendlier

hydropower generation (CS#18, CS#15). The impact of these EPIs on rivers remains unclear. In spite of the several measures and actions that have been taken to improve the water status in both case studies, there are no comprehensive studies showing the overall change in the ecological status of the water bodies. However it can be concluded that, at least for the German case (CS#18), there was an improvement of water bodies next to hydropower plants fulfilling environmental conditions, although again the magnitude cannot be exactly determined.

- Finally, there is scope for subsidies whose objective is not necessarily targeting the mitigation of negative environmental effects from hydropower installed capacity, but basically the extended use of the technology, supported by command-and-control measures (CS#17). Although not the very instrument, but the policy mix it belongs to, can be considered a real contribution to the ecological status of improvement of water bodies as required by the WFD.

Lessons learnt

- **EPIs are still part of a new approach to water policy.** Stavins (2001) described "market-based instruments" (just a type of EPIs), as a "relatively new set of policies". More than 10 years later, they can still be seen as new to a large extent. This remains fundamentally true despite their recent upsurge. Although EPI-Water's *ex-post* assessment of 30 case studies is extensive, this should not leave the reader with the impression that EPIs have replaced, or are close to replacing, the dominant command-and-control approach to water management. Furthermore, even in those places where these "new" approaches have been used in a very genuine form and somewhat successfully (such as water quality trading systems in the US or water use right markets in Chile, Australia or again the US, for instance), they have not always performed as anticipated.
- **Information quality, a critical factor but not an alibi.** There remains a great deal of uncertainty especially over the potential role of pricing-based EPIs, and water use right trading systems, for water demand management and allocation. EPI-Water is aimed at shading light on this 'twilight'. To date, it is clear that reducing uncertainty would be highly contingent on the improvement of information systems and the availability of proven facts and testable empirical evidence. However, one should not conclude that nothing relevant might be said because of the lack of information, since this is also an essential characteristic of the assessment of command-and-control instruments. Decision-making on water management will definitely be improved with better information but cannot be dependent just on that. Information, after all, is not the only (scarce) element of decision-making.

- **Neither generalization nor relativism.** Conclusions hereby presented cannot be generalized to all EPIs and situations. This is but the synthesis of conclusions after the *ex-post* assessment of 30 case studies. On one hand, though, it must be recognized that such comprehensive assessments are not very recurrent in the literature; on the other, further work in this project (WP4 to WP6) will allow us to draw some conclusions on the transferability of some of these experiences. Maximalism would be a mistake but so would be strict relativism.
- **Failure of an EPI does not necessarily mean a flawed EPI.** The review of experiences based on pricing (including taxes and fees), reveals that while they can have some effect in reducing water use, it is not clear, at this stage of this research project, that they are always more effective in doing so than other instruments. This does not preclude anything about their soundness but rather points out the need to emphasise on the delivery mechanism (that is on instrument-design issues). The failure of an EPI to meet its pre-determined objectives is not necessarily equivalent to a flawed EPI but the symptom of a bad design (not to mention other institutional variables).
- **Different objectives of water policy.** EPIs are argued to be able to fulfil one or more social objectives: financial sufficiency of water policies, economic development, and environmental sustainability, amongst others (i.e. equity concerns). This implies that they may play different roles: an incentive function, a fiscal or financial one (not necessarily the EPI itself but a linked financial instrument), part of a liability regime, etc. Thus, the choice and design of the EPI should depend on which functions the instrument is desired to address. In the restricted conditions of a perfectly competitive market the price that falls out of the market, for instance, is argued to fulfil all three objectives. But in reality it may be preferable to address the three different functions separately and not to assume the best approach for one is the best approach for all.
- **One goal, one instrument: a sensible approach.** Cost-recovery (i.e. revenue raising) concerns have traditionally been the primary driver of reforms to water pricing. As the reader may have seen in the above analysis in this report, though, despite being a legitimate social objective, cost-recovery is *not* an economic goal but a financial (thus instrumental) one. Financial goals should be clearly distinguished from economic incentives, aimed at inducing chosen behavioural changes. Cost-recovery mechanisms do emphasise on revenue collection (e.g. who covers fixed costs, what tariff structure is more convenient to maximize income, etc.). Hence, the way these questions are addressed does not necessarily have anything to do with efficient pricing, whose motivation should be to optimise water use and social welfare.
- **High potential for EPIs aimed at environmental objectives.** A relative success can be claimed for on the grounds of cost-recovery and economic development (i.e. hydropower expansion); however, results are definitely

more uneven as to their environmental outcomes. This poses a challenge for EPI-Water, since there is room for innovative *ad-hoc* EPIs to meet specific environmental objectives: tackling water scarcity and droughts, managing flood risks, improving water quality, restoring damaged water ecosystems, etc.

- **The divergent role of information in instrument comparison.** Transaction costs have precluded some actions which might otherwise be desirable from an efficiency perspective e.g. charging domestic consumers the actual cost of wastewater collection and treatment; that is, according to volume and load of pollutants. Conversely, some charging systems (e.g. charging surface water runoff by the volume produced) have only become possible with the reduction in transaction costs e.g. the availability of GIS databases of land use. In water management, information has typically been expensive and can be considered as part of transaction costs, EPIs typically require more differentiation (and hence more information than command-and-control systems). In a complementary sense, EPIs save information as well (i.e. setting a price and observing behaviour is not that demanding, markets might be a way of revealing preferences, etc.).
- **A critical question: the definition of water rights.** A critical issue in the implementation of markets is a clear but nonetheless full definition of water rights or entitlements and of the associated risks. It is also important to account for the interactions between surface and groundwater resources (no specific provisions can be found in many of the assessed systems). Setting a trading scheme can be an answer to managing competing water demands, especially in scarcity-prone areas. Main concerns, though, remains on third-party effects (for instance, linked to the definition of rights on water return flows) and environmental externalities, as well as transaction costs (which should be minimized but not neglected, since they play no minor roles in some occasions).
- **The paramount importance of the policy mix.** EPIs are usually only one element of a larger policy mix. They are often combined with other policy instruments (being EPIs or not), into a water policy or management strategy. EPIs are therefore never implemented in isolation and should be assessed as a part of larger policy packages. Innovative EPIs do not need to be 'new' EPIs but rather better designed (but well-known) instruments or the combination of a number of them.
- **Economic incentives for behavioural change.** Pricing and trading schemes are not always easy to implement (due to high transaction costs, equity concerns, social acceptability, institutional complex demands, etc.). The same could be said of payments for environmental services, which are also difficult to implement in societies with advanced water regulations and institutions, especially in EU countries where water resources are public-domain assets and where private (use) rights can only be issued under certain conditions.

Side payments for good practices are not easy to accommodate within existing regulations in most EU countries and will require important legal amendments besides other transaction costs. All these considerations may lead the reader to think of a reduced scope for EPI implementation. However, this assessment shows that the potential for voluntary agreements based on economic incentives is high. This will be further explored in the project. At the end of the day, what defines an EPI is not an explicit monetary payment (although most of them will imply one), but the economic incentive to modify behavioural patterns regarding water use.

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